

Diabetes in Athletes

Background

1. Definition

- Person with diabetes participating in athletic activity

2. General info

- In persons without diabetes, blood glucose well-maintained during exercise
 - Hypo- or hyperglycemia during exercise in non-diabetic patient- extremely uncommon
- Type I diabetics lose adaptation to maintain blood glucose during exercise
 - Diabetic ketoacidosis
 - Hypoglycemia
- Type II diabetics- less problems with hypoglycemia during exercise
- Intensive diabetes management needed to balance insulin, carbohydrate intake and exercise
- Goal:
 - Allow persons with diabetes to participate in a wide range of athletic activities

3. ADA/ACSM Joint Statement:

- Diabetes Mellitus and Exercise
- <http://www.acsm-msse.org/pt/pt-core/template-journal/msse/media/1297.htm>

4. ACSM Position Stand:

- Type II Diabetes and Exercise
- <http://www.acsm-msse.org/pt/pt-core/template-journal/msse/media/0700.pdf>

5. Diabetes Exercise and Sports Association:

- <http://www.diabetes-exercise.org>
- Resource for athletes with diabetes

Pathophysiology

1. In athletes

- Exercise-induced glucose uptake can cause hypoglycemia
- Late onset hypoglycemia after exercise
- Exercising with elevated blood sugar can cause paradoxical increase in blood sugar
 - Epinephrine, norepinephrine, glucagon, growth hormone, cortisol- released during very intense exercise- lead to increased blood glucose
 - Can lead to diabetic ketoacidosis (DKA)
- Blood sugar during exercise influenced by:
 - Time of day
 - Decreased risk of hypoglycemia in early morning
 - Low circulating levels of insulin
 - Higher cortisol levels
 - Timing of insulin or oral hypoglycemic administration
 - Do not use short acting insulin immediately before exercise
 - Insulin injection site
 - Areas with increased fat density (abdomen) slow absorption of insulin
 - Areas with decreased fat density (legs) increase absorption of insulin

- Time of last meal
 - Splanchnic circulation decreased during exercise
 - Slows absorption of food
- Type of food
 - Fatty foods digest/absorb more slowly
- Blood sugar level prior to exercise
- Intensity of exercise
- Ambient temperature
- Hydration status
- Acute illness
 - Increased blood glucose levels
 - More difficult to estimate insulin/carbohydrate needs

2. Morbidity / mortality

- Hypoglycemia
 - Blood sugar <70 mg/dL
 - Increased risk during physical activity
 - Imbalance of increased glucose uptake with inadequate hepatic glucose release
- Diabetic ketoacidosis
 - Increased risk in diabetics during exercise secondary to hypoinsulinemia induced by physical activity
 - Hypoinsulinemia → decreased glucose uptake → reliance on fat for energy → ketosis
- Dehydration
 - Some athletes withhold insulin and fluid intake to make weight
 - Wrestling, boxing, weightlifting
- Cardiovascular disease
 - Increased risk of hypertension
 - Consider exercise testing before allowing athletic participation in certain individuals
 - Age >35 years
 - Type 2 diabetes >10 years duration
 - Type 1 diabetes >15 years duration
 - Presence of any additional risk factor for coronary artery disease
 - Presence of microvascular disease (retinopathy or nephropathy, including microalbuminuria)
 - Peripheral vascular disease
 - Autonomic neuropathy
- Peripheral vascular disease
 - May improve with low intensity exercise
- Nephropathy
 - Strenuous exercise is contraindicated
- Autonomic neuropathy
 - Maintain adequate hydration
 - Avoid exercise in hot/cold environment
 - Cannot use heart rate as a measure of exercise intensity in these patients
- Peripheral neuropathy
 - Diabetic foot ulcers secondary to decreased proprioception and pain
 - Poor glycemic control is associated with decreased wound healing

- Significant neuropathy:
 - Limit the intensity of exercise
 - Limit weight bearing exercise
 - Athletes with diabetes with/without neuropathy should:
 - Use supportive athletic shoes
 - Use gel inserts to avoid blisters/trauma
 - Gastroparesis
 - Retinopathy
 - Avoid anaerobic exercise, straining, Valsalva, and jarring
 - Female athletes with type I diabetes in running, cheerleading, gymnastics, ballet
 - May be at increased risk for Female Athlete Triad
 - Attempt to decrease weight by skipping or using less insulin
 - Performance enhancement may interfere with diabetes control
 - Unsafe diets
 - Nutritional supplements
 - Ergogenic aids
 - Illegal drugs/anabolic steroids
3. Benefits of exercise in persons with diabetes
- Increased muscle mass, decreased body fat
 - Improved glycemic control
 - Decreased requirements for insulin therapy
 - Decreased cardiovascular risks
 - Increased HDL cholesterol
 - Decreased LDL cholesterol, triglycerides
 - Decreased blood pressure
 - Decreased risk of thrombosis
 - May enhance weight loss
 - Enhanced self-esteem, team work, skills mastery

Therapeutics: Type 1 Diabetes

1. Medications
 - Review types of insulin, doses, use of insulin pump
2. Guidelines for athletes/exercisers with diabetes
 - Pre-Participation Evaluation
 - Similar to pre-participation in other athletes
 - Assess diabetes knowledge and self care skills
 - Review blood sugar log/labs
 - Review episodes of hypoglycemia and DKA
 - Sick day plan
 - Treatment for hypoglycemia symptoms
 - Glucose tabs
 - Glucagon
 - Understand insulin onset and duration
 - Understand insulin pump
 - Understand carbohydrate counts
 - High risk sports for athletes with diabetes
 - Skydiving
 - Scuba diving

- Rock climbing
 - Activities far from medical facilities
- Obtain metabolic control before exercise
 - Exclude athlete from participation if:
 - Blood sugar >250 mg/dl with ketosis (via urine testing)
 - Blood sugar >300 mg/dl with or without ketosis
 - Delay an athlete from participation if
 - Blood sugar is <100 mg/dl
 - Blood sugar should be 150-180 mg/dl before participation
- Blood glucose monitoring done before, during, and after exercise
 - Identify when changes needed in insulin
 - Decrease intermediate acting insulin by 30% on days of intense exercise
 - Do not use rapid acting insulin just before exercise
 - Insulin pump users
 - Should not give themselves a bolus infusion for the meal just prior to or just following exercise
 - May need to adjust basal insulin during and shortly after activity
 - Do not inject insulin into muscles that will be or have recently been exercised
 - Exercised muscle has increased insulin absorption
- Food/fluid intake
 - Carbohydrates should be consumed to avoid hypoglycemia
 - Prior to exercise, 15-30 g for every 30 minutes of intense exercise
 - After exercise, consume carbohydrates within 30 minutes to avoid late onset hypoglycemia
 - Carbohydrates should be available to athlete during and after exercise
 - Glucose tablets
 - Carbohydrate rich foods (fresh fruits, bars)
 - Avoid dehydration
 - Athletes with diabetes are at high risk of dehydration
 - Elevated blood sugar causes increased sugar in the urine which leads to polyuria
 - Hydrate before, during, after exercise
 - Diluted fruit juices and sport drinks
- Severe hypoglycemia
 - Oral glucose load 15-30 g of carbohydrate, if able
 - If unable to take oral glucose, glucagon should be administered 1 mg IM/SC
 - Follow with oral glucose load
 - Glucagon has short duration of activity
- Additional nutritional recommendations
 - Calcium
 - Diabetes increases bone mineral loss
 - Chromium
 - May increase insulin sensitization
 - Zinc
 - Used in glucose metabolism

- Antioxidants
 - May minimize oxidative tissue damage
- Pearls
 - Avoid evening exercise
 - Increases risk of nocturnal hypoglycemia
 - Remove pump for collision sports
 - Athlete may require subcutaneous injection of long- acting insulin on participation days
 - Athletes with diabetes should wear medic alert tag while exercising
 - Coaches, players, and parents should be trained in:
 - Signs/symptoms of hypoglycemia
 - Emergency treatment of hypoglycemia
 - Glucose monitoring

Therapeutics: Type 2 Diabetes

1. Review medication doses, use of insulin

2. Guidelines

- Exercise recommended to persons with type 2 diabetes to control their blood sugar and decrease diabetic complications
 - Assists with insulin sensitization
 - Assists with glucose utilization at the tissue level
 - Decreases hepatic glucose production
 - Increases oxygen delivery to peripheral tissues
 - With consistent exercise, may be able to discontinue or decrease oral hypoglycemics/insulin
 - HgA1C improvement of 10-20% may be possible with exercise
 - Decreases risk of hypertension
 - Lowers lipids
 - Encourages weight loss/decreases body fat
- Obtain metabolic control before exercise
 - Exclude athlete from participation if:
 - Blood sugar is >250 mg/dl with ketosis (urine testing)
 - Blood sugar is >300 mg/dl with/without ketosis

3. Type of exercise

- Low to moderate aerobic activity 30-60 minutes 5 days or more per week
 - Goal energy expenditure of 1,000 kcal/week from aerobic activity
 - Intensity 40-70% of VO₂ max
 - An RPE (rating of perceived exercise) scale can be used to monitor intensity of physical activity
- Resistance training:
 - Build muscle mass
 - Increasing endurance

4. Avoid hypoglycemia

- Less common in type 2 diabetes
- Oral hypoglycemics (sulfonylureas) or insulin may need to be adjusted during exercise

5. Avoid dehydration
 - Difficult if blood sugar poorly controlled
 - Elevated blood sugar causes glucosuria/polyuria
 - Increase fluid intake before, during, after exercise

References

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