Diabetes in the Young Athlete

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Disclosures

- None
- Photos are not real patients

Outline

The Disease
- Epidemiology
- Pathology
  - What is diabetes?
  - Type I vs Type II
  - Complications

The Athlete

PATIENT CASE
- Diagnosis
- Treatment
- PPE/Preparticipation Considerations
- Complications
  - Acute
  - Chronic
- Monitoring the diabetic athlete
- What to have in your bag
- Injuries and glucose control

The Disease

The Athlete
Epidemiology

- Total: 25.8 million children and adults in the United States—8.3% of the population—have diabetes.
  - Diagnosed: 18.8 million people
  - Undiagnosed: 7.0 million people
  - Prediabetes: 79 million people
  - Lifetime risk of developing diabetes = 33% (men); 39% (women)

Pediatrics:

- Under 20 years of age
- 215,000, or 0.26% of all people in this age group have diabetes
- About 1 in every 400 children and adolescents has diabetes
- Men:Women is equal
Diabetes – What is it?
Types of Diabetes

- Type 1
- Type 2
• AKA
  • Childhood / Adolescent Diabetes
  • Juvenile Diabetes
  • IDDM

INSULIN
Mean age of onset: 8-12

Pathophysiology:

- Felt to be an autoimmune condition

- Alteration in immune response places beta-cells at risk for inflammatory damage

- Autoantibodies to Islet cells have been identified
- Commonly Associated Conditions:
  - Celiac Disease
  - Addison Disease
  - Hypothyroidism
  - Other Autoimmune conditions
• AKA
  • NIDDM
  • Adult-Onset DM
"Use it or Lose it"

Decrease in Beta cell function and Mass = \( \downarrow \) Insulin secretion
- Risk Factors:
  - BMI>25
  - Hypertriglyceridemia
  - African american > Latino > Native american > Asian American
  - Sedentary lifestyle
  - Family Hx of DM
  - Gestational diabetes
Commonly Associated Conditions:
- HTN
- Hypercholesterolemia
- Stroke
- ED
- Infertility
- Pancreatic cancer
- Acanthosis nigricans
<table>
<thead>
<tr>
<th></th>
<th>Type 1</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Diagnosis</strong></td>
<td>Typically diagnosed in early childhood or adolescence or early adulthood</td>
<td>Usually Dx in adulthood, although this is changing</td>
</tr>
<tr>
<td><strong>Mechanism</strong></td>
<td>Insulin Deficiency</td>
<td>Decreased Insulin utilization</td>
</tr>
<tr>
<td><strong>Complications</strong></td>
<td>Hyperglycemia, weight loss, DKA</td>
<td>Obesity, HTN, hyperlipidemia</td>
</tr>
<tr>
<td><strong>Demographics</strong></td>
<td>Younger, more fit population</td>
<td>More common in older, overweight individuals</td>
</tr>
</tbody>
</table>
Where it all starts:
The Pancreas
Normal Glucose Metabolism

Absorption

FOOD

Normal Glucose Regulation

- Glucose -> Glycogen
- Glucose + 3 Fatty Acids -> Triglycerides
- Glycogen -> Glucose

Achieve Normal Blood Glucose Levels

Liver

Insulin Release by Beta Islet Cells

Pancreas

Muscle

Adipose Tissue
Abnormal Glucose Metabolism

Diabetes Mellitus Type 1

Excess Carbohydrates Intake → High Blood Glucose

- Beta Cell Destruction - No Insulin Produced
- Normal or No Carbohydrate Intake

Glucose → Glycogen

Liver: Blood Glucose Levels Remain High

Muscle: Glucose + 3 Fatty Acids → Triglyceride

Adipose Tissue: Inhibits
Glucose Metabolism during Exercise

- Insulin is suppressed
  → More glucose released from liver

- Muscles = ↑ sensitivity to insulin = more efficient glu uptake into muscle

- Blood glucose levels decrease
Insulin levels rise
→ Excess glucose gets stored in muscle and fat.
Diabetes – so what?

Complications of Diabetes Mellitus

Macrovascular

- Brain
  - TIA, CVA, Dementia

- Heart
  - ACS
  - CHF

Microvascular

- Eye
  - Retinopathy
  - Glaucoma
  - Cataracts

- Renal
  - Microalbuminuria
  - Nephropathy
  - ESRD

- Neuropathy
  - Peripheral
  - Autonomic

PVD
Complications

- In 2004:
  - 70% of all diabetes related deaths were due to cardiac disease
  - 16% of all diabetes related deaths were due to stroke

- Risk of stroke or heart disease is 4 x higher in diabetics

- #1 cause of blindness in the US

- #1 cause of kidney failure

- > 200,000 people a year are on dialysis b/c of diabetic nephropathy

- 70% of diabetics have neuropathy

- #1 cause of atraumatic amputations in the US
The Diabetic Athlete

- One Athlete's Story
A 16yo high school female soccer player and T&F athlete presents for her annual examination and reports feeling well except for increased burning with urination and some urinary frequency over the past 5 days.

Her physical examination is unremarkable and her vital signs, including her blood pressure are within normal limits.

She submits a urine sample.
The urine analysis shows:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Result</th>
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</thead>
<tbody>
<tr>
<td>Color</td>
<td>Yellow</td>
</tr>
<tr>
<td>Clarity</td>
<td>Clear</td>
</tr>
<tr>
<td>Spec Grav</td>
<td>1.030</td>
</tr>
<tr>
<td>Glucose</td>
<td>Positive</td>
</tr>
<tr>
<td>Ketone</td>
<td>Positive</td>
</tr>
<tr>
<td>Nitrite</td>
<td>+</td>
</tr>
<tr>
<td>Leuk Est</td>
<td>+</td>
</tr>
<tr>
<td>WBC</td>
<td>4-8/hpf</td>
</tr>
<tr>
<td>Protein</td>
<td>Positive</td>
</tr>
</tbody>
</table>
Diagnosis

- Urinary Tract Infection
- Question Type 1 DM
Diabetes work-up

Diagnostic Criteria

- Fasting blood glucose > 126 mg/DL
- Random blood glucose > 200 mg/DL
- HbA1C level > 6.5%
- Glucose tolerance test: blood glu > 200 mg/DL, 2 hours after a glucose load
Diagnosis

- Scenario 1 – Incidental
- Scenario 2 – The symptomatic athlete
- Scenario 3 – The hospitalized youngster
Famous Diabetic Athletes

Gary Hall Jr – Olympic Champion
50m freestyle

Kelli Kuehne
Treatment

- Exercise

- Nutrition

- Medications (insulin)

“It wasn’t really insulin. You don’t have diabetes yet. It was just a warning shot.”
Exercise is Medicine:
- Improves glucose metabolism
- Improves insulin sensitivity
- Can reduce the use of PO medications and insulin

Participation in team sports = ↓Macrovasc complication and ↓ mortality *

# Diet – Glycemic Index

## Glycemic Index of foods

<table>
<thead>
<tr>
<th>CHO</th>
<th>CHO + Fats</th>
<th>Fats</th>
<th>Fruits</th>
<th>Vegetables</th>
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</thead>
<tbody>
<tr>
<td><strong>High Glycemic Foods</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>Maltodextrin (95)</td>
<td></td>
<td>Dates (100)</td>
<td>Parsnip (85)</td>
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<tr>
<td></td>
<td>White Bagette (85)</td>
<td></td>
<td></td>
<td>Watermelon (72 - 85)</td>
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<tr>
<td></td>
<td>Special K (84)</td>
<td></td>
<td>Baked Sweet Potato (82)</td>
<td></td>
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<tr>
<td></td>
<td>Coco pops (79)</td>
<td></td>
<td>Swede (80)</td>
<td></td>
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<tr>
<td></td>
<td>Bagel/Weetabix (72)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Wholemeal Bread (70)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Medium Glycemic Foods</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>55</td>
<td>Cous Cous 65</td>
<td>Choc Ice-cream (68)</td>
<td>Pineapple (66)</td>
<td>Beetroots (65)</td>
</tr>
<tr>
<td></td>
<td>Pancake (60)</td>
<td>Cheese pizza (63)</td>
<td>Jam (65)</td>
<td>Potatoes (60)</td>
</tr>
<tr>
<td></td>
<td>Basmati Rice (58)</td>
<td>Spaghetti bol (60)</td>
<td>Melon (60)</td>
<td>Sweetcorn (58)</td>
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<tr>
<td></td>
<td>Wild Rice (57)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Popcorn (56)</td>
<td></td>
<td>Orange Juice (55)</td>
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<tr>
<td></td>
<td>Buckwheat (51)</td>
<td></td>
<td>Ripe Banana (53)</td>
<td>Peas (50)</td>
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<tr>
<td></td>
<td>Wholegrain Rice (50)</td>
<td></td>
<td>Kiwi (50)</td>
<td>Raw carrot (49)</td>
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<tr>
<td></td>
<td>Porridge Oats (49)</td>
<td>Museli (40 - 50)</td>
<td>Coconut (45)</td>
<td>Raw Sweet Potato (44)</td>
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<tr>
<td></td>
<td>Bulgar Wheat (46)</td>
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<tr>
<td><strong>Low Glycemic Foods</strong></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>0</td>
<td>Raw Sweet Potato (44)</td>
<td>Skimmed Milk (35)</td>
<td>Strawberries (40 - 47)</td>
<td>Peppers (15)</td>
</tr>
<tr>
<td></td>
<td>Wholewheat Pasta (36)</td>
<td>Full fat milk (31)</td>
<td>Grapes (45)</td>
<td>Broccoli (15)</td>
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<tr>
<td></td>
<td>Quinoa (25)</td>
<td>Natural Yoghurt (33)</td>
<td>Apple (28 - 44)</td>
<td>Lettuce (13)</td>
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<tr>
<td></td>
<td>70% Chocolate (25)</td>
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<td>Pears (33)</td>
<td>Runner bean (10)</td>
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<td></td>
<td>Olives (15)</td>
<td></td>
<td>Cashew Nuts (23)</td>
<td></td>
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<tr>
<td></td>
<td>Nuts (15)</td>
<td></td>
<td>Grapefruit (25)</td>
<td></td>
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<tr>
<td></td>
<td>Houmous (6)</td>
<td></td>
<td>Blueberry (25)</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulin</td>
<td>Action</td>
<td>How to use</td>
<td>Length</td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>----------</td>
<td>-----------------------------------------</td>
<td>--------------</td>
<td></td>
</tr>
<tr>
<td>Humalog</td>
<td>Rapid</td>
<td>Bolus in MDI</td>
<td>Minutes</td>
<td></td>
</tr>
<tr>
<td>Novolog</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Humulin N</td>
<td>Fast</td>
<td>Bolus in MDI</td>
<td>2-4 hours</td>
<td></td>
</tr>
<tr>
<td>Novolin N</td>
<td>Intermediate</td>
<td>Basal dose inj</td>
<td>4-10 hours</td>
<td></td>
</tr>
<tr>
<td>Lantus</td>
<td>Long</td>
<td>Basal dose inj</td>
<td>1 day</td>
<td></td>
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<tr>
<td>Detemir</td>
<td></td>
<td></td>
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</tbody>
</table>
Insulin

- Multiple Daily injections (MDI)
Insulin

- Pump

An insulin pump can be worn discreetly under clothing as it administers insulin to the diabetic.
The PPE

- History / Discussion should include:
  - Assessment of self-care skills and knowledge of disease
  - Discuss how exercise will affect blood glucose control
  - An assessment of current glycemic control (HgbA1c)
  - Information regarding the presence of DM-related complications
The PPE

- Physical examination should include:

<table>
<thead>
<tr>
<th>Complication</th>
<th>Examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brain</td>
<td>Cognitive evaluation</td>
</tr>
<tr>
<td>Heart</td>
<td>Complete cardiovascular examination</td>
</tr>
<tr>
<td>PVD</td>
<td>Peripheral pulses</td>
</tr>
<tr>
<td>Eyes</td>
<td>Dilated ophthalmologic exam annually</td>
</tr>
<tr>
<td>Kidneys</td>
<td>Urinalysis to assess proteinuria annually</td>
</tr>
<tr>
<td>Nerves</td>
<td>Monofilament and reflex exam</td>
</tr>
</tbody>
</table>
Pre-participation Considerations

- ADA guidelines recommend screening for diabetic complications before participation

- Diabetic athletes should wear MedicAlert bracelet
Acute Complications

- Hypoglycemia
- Hyperglycemia
Common Problems Encountered with Diabetic Athletes

“Medical”
- Hypoglycemia
  - Immediate
  - Delayed
- Hyperglycemia
- Ketoacidosis
- Proliferative Retinopathy
- Nephropathy
- Peripheral Neuropathy

“Orthopedic”
- Fascial Disease
- Adhesive Capsulitis
- Tendon pathology
- Flexor tenosynovitis
- Nerve entrapments
Hypoglycemia

- Typically only happens to patients who take insulin

- Exercise is the #1 cause

  - ↑ Absorption of insulin during exercise
  - ↑ Sensitivity to insulin during exercise
  - Exogenous insulin does Not decrease during exercise like endogenous insulin does
Hypoglycemia

- Symptoms occur with blood glucose < 70mg/dL

- Symptoms:
  - Tachycardia
  - Sweating
  - Palpitations
  - Hunger
  - Anxiety
  - Headache / dizziness
  - Blurred vision, seizure, coma
Hypoglycemia

- Treatment = PREVENT IT
  - Blood Glucose Monitoring
  - Carbohydrate supplementation
  - Insulin Adjustments

- Treatment = Give Glucose!
Hypoglycemia

- Blood Glucose monitoring
  - Before Exercise: 2-3 times to check the trend
    → levels <70mg/dL = Postpone exercise
  - During exercise: q 30 mins
  - After: q 2 hrs x 2 to check for Post-Exercise hypoglycemia
Hypoglycemia

Carbohydrate Supplementation

- **Pre-Exercise** → Carb rich meal 2-4 hours before exercise.
  → Additional 15-30g of Carbs within 1 hour of exercise

- **During** → Additional 30-100g for every hour of exertion

- **Post** → 1.5g/Kg of CHO per hour x 4 hours
  → Restart insulin at this meal
Hypoglycemia

- Insulin Adjustments

- Insulin Pump:
  - ↓ basal rate by 20-50% 1hr before exercise
  - ↓ Bolus by 50% at meal preceding exercise
  - Disconnect pump at exercise onset

- Multiple Daily injector
  - ↓ Bolus by 50% at meal preceding exercise
Hypoglycemia

Mild Hypoglycemia

Athlete following commands

↓

10-15g of glucose tablets or honey

↓

Re-check blood glu in 15 mins

↓

10-15g of glucose tablets or honey

↓

Glucagon
Hypoglycemia

Severe Hypoglycemia

Athlete unable to follow commands

Glucagon
Normal Glucose Metabolism
Hyperglycemia

Why would an athlete get HYPERglycemic?
Hyperglycemia

Typically occurs with High-Intensity Exercise

(70% VO2 max or >85% MHR)
Hyperglycemia

1. Under-insulinization

\[ \downarrow \text{Insulin} = \uparrow \text{Hepatic Glucose production} \]
Hyperglycemia

2 - Hormones

\[
\text{HIE} = \uparrow \text{Catecholamine} = \uparrow \text{FFAs} = \downarrow \text{Muscle utilization of glucose} = \uparrow \text{Blood Glu}
\]

\[\uparrow \text{Ketones}\]
Hyperglycemia

3 - Psychological Stress

\[ \uparrow \text{Stress} = \uparrow \text{Counterregulatory hormones} = \uparrow \text{Blood Glu} \]

* Insulin mgmt strategies from practice may not work on game day
Hyperglycemia

4 - Performance

Competing in a hyperglycemic state:

1) ↑ Risk for dehydration
2) ↓ Performance
3) ↑ Ketosis
4) Does NOT ↓ risk of hypoglycemia
Hyperglycemia

- Symptoms
  - Nausea
  - Dehydration
  - ↓ Cognition
  - ↓ Reaction time
  - Fatigue
  - Thirst
  - Increased urination
  - Kussmaul breathing
  - Fruity odor on breath
# Hyperglycemia Guidelines

<table>
<thead>
<tr>
<th>Blood Glucose Levels</th>
<th>Action</th>
</tr>
</thead>
</table>
| > 250 mg/dL          | - Check urine for ketones  
 + Ketones = No exercise  
 - Ketones = Exercise with caution |
| > 300 mg/dL          | Exercise inadvisable |
Chronic Complications

Diabetes: Microvascular Complications

- Leading cause of blindness in working age adults
- Diabetic Retinopathy
- Diabetic Nephropathy
- Leading cause of end-stage renal disease
- Leading cause of nontraumatic lower extremity amputations

Monitoring the DM Athlete

- HgbA1c
  - Provides a long-term prospective about glucose control but should NOT be used to make day-to-day decisions.
Diabetes Care Plan

- All DM athletes and their ATCs should have a care plan in place
- Which includes:
  - Blood glu monitoring guidelines
  - Insulin therapy guidelines → Dosing and adjustment strategies
  - Guidelines for Hyper-/Hypoglycemia detection and management
  - Emergency contact info
The Sideline Bag: What to have on hand

- Copy of Diabetes care plan
- Equipment to monitor blood glucose levels
- Supplies to Tx hypoglycemia
  - Sugary foods / drinks
  - Glucagon injection kit (supplied by athlete/parents)
- Supplies for urine ketone testing
- Sharps container
- Spare batteries / infusion sets for insulin pumps
Injuries and Glucose control

Trauma = ↑ Stress Hormones = ↑ Blood glucose

↑ infection, ↓ wound/Fx healing*

Glucose Targets:
• Premeal = 110 mg/dL
• Postmeal < 180 mg/dL


Summary:

Role of the ATC in caring for the diabetic athlete
- Prevent / Recognize / Care of hypo and hyperglycemia
- Exercise nutrition
- Hydration counseling
- Facilitate communication between providers/coaches etc
Thank-you