Diabetes Care for the School Age Child

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Learning Objectives

• Background/History
• Type 1 Diabetes
• Type 2 Diabetes
• Living with Diabetes
  – School Management
• Established by a generous $5 million donation in 2013 from the Lift-a-Life Foundation

• Mission:
  – Provide state-of-the-art, advanced diabetes care to children and young adults
  – Enhance medical/community diabetes education programs
  – Enhance childcare, school management programs
  – Expand diabetes research, particularly advanced technology and therapeutic options for children

Director: Ashley Novak Butler
liftalifefoundation.org
Patients and Families

- Will serve nearly 1,300 children with all forms of diabetes mellitus including:
  - type 1 diabetes mellitus
  - type 2 diabetes mellitus
  - Cystic Fibrosis related diabetes (CFRD)
  - genetic beta cell defects/MODY
  - medication/treatment related forms of diabetes
• Inpatient Facility (expected Fall 2013):
  – Kosair Children’s Hospital (Louisville, KY) - 280-bed, free-standing, full-service teaching hospital serving Kentucky and Southern Indiana.

• Outpatient Facilities:
  – Central office in Downtown Louisville with 4 satellite offices located strategically throughout the state.
Diabetes and vacation

Vacations are meant to be a time for rest and relaxation, a time for cares to melt away. As we all know, though, diabetes can add a bit of stress during even the shortest getaways. Preparation is the key to a safe, fun-filled adventure.

**Adventure Guide**

- Pack plenty of supplies, twice as much as you think you will need (think underwear). That includes an extra blood glucose meter and batteries. If you wear a pump, some companies will send you a vacation loaner as a back up pump.
- Always wear medical identification explaining that you have diabetes.
- Make a doctor list, including names and phone numbers. If a dolphin swims off with your insulin pump, you will be able to make that quick, easy call.
- If traveling by car, remember that your diabetes supplies are a bit wimpy, so never leave them in the car unless they are in a cooler.

**Flying the Friendly Skies:**

- To avoid confusion and extra stress, check out your rights and the regulations for carrying your supplies: Transportation Security Administration hotline for those with medical conditions (1-866-787-2227) or website (www.tsa.gov).
- TSA recommends that those wearing an insulin pump or glucose sensor alert security officers BEFORE being screened. The TSA website provides a downloadable notification card that will discreetly reveal that you are wearing a medical device.
  - Helpful Hint: This will lead to a security pat down (we all love those), but the line is usually very short!
- Keep ALL of your insulin and vital diabetes supplies in your carry-on. Remember, insulin is wimpy and does
Type 1 Diabetes
Defined in Time

“In an increasingly complex world, sometimes old questions require new answers.”
Diabetes – Defined in Time

1552 B.C. - 3rd Dynasty Egyptian papyrus by Over the years, diabetes was described in various ways:

- 1552 B.C. - 3rd Dynasty Egyptian papyrus by Hesy-Ra, a physician, mentions polyuria as a symptom of diabetes.
- 230 B.C. - Apollonius of Memphis, a Greek physician, names the disease diabetes.
- 164 A.D. - Galen, a Greek physician, mistakenly diagnoses diabetes as an ailment of the kidneys.
- 1675 - Thomas Willis - mellitus' is added to diabetes.
- 1850 - Priorry identifies a high sugar diet as a cause of diabetes.
- 1903 - Von Noorden prescribes an oatmeal diet for diabetes.
- 1869 - Langerhans, a medical student, identifies two cell types in the pancreas.

Wendy L. Novak, Diabetes Care Center
United States

1908 – Joslin – diet and exercise

1920 – Banting, University of Toronto

1915 – Allen – "starvation treatment"
• **1921** - Frederick Banting and Charles Best (and Collip and Macleod)
Early Human “Trials”

• 1922 - Insulin first used successfully in humans
1923 - Eli Lilly begins commercial production of insulin

1940 - Miles Laboratories develop the first convenient glucose detection tablet

1969 - Ames Diagnostics creates the first portable blood glucose meter

1970s - Glucose meters and insulin pump development advances
Improving What We Have

• 1982 - First biosynthetic human insulin is introduced.
• 1996 - First recombinant “fast-acting” analog insulin.
• 2000 - First “long-acting” basal analog insulin.
• 2003 - Define: Type 1 and Type 2 formally introduced.
• American Diabetes Association (ADA)
  – HbA1c > 6.5%*
  – Fasting glucose >126 mg/dl
  – Random glucose >200 mg/dl with symptoms
  – 2 hr post-prandial glucose >200 mg/dl during Oral Glucose Tolerance Test (OGTT)
Type 1 Diabetes: Etiology

“Diabetes has increased dramatically over the past 10 years. That proves that diabetes is caused by global warming!”
Type 1 Diabetes Mellitus

Genetics
- DR3: Significant Risk
- DR4: Risk

Insulitis

Environmental triggers
- Viruses
- Bacteria
- Fungi
- Allergens

Type 1 Diabetes

Diabetes Exposure

- Eye Complications
- Renal Complications
- Large Vessels
Type 1 Diabetes Mellitus

Time Course of Diabetes

- Trigger?
- Clinical Presentation
- Insulin resistant periods

Percent

0 20 40 60 80 100

Time .....
Type 1 Diabetes: Clinical Presentation
Energy Metabolism

- Urea Cycle
- Citric Acid Cycle
- Electron Transport Chain
- Fats and Lipids: fatty acid, glycerol
- Lactic acid
- $\text{NH}_3$, $\text{CO}_2$, urea, ATP, H$_2$O
Glucose Homeostasis

- When Good Cells Go Bad
  - Insulin
  - Glucagon
Modes of Discovery

- **Incidental hyperglycemia**
  - Routine sports PE
  - Relative with diabetes
  - Research trial screening
- "Classic symptoms," No DKA
- **Diabetic ketoacidosis**
  - 25-40% of newly diagnosed
Type 1 Diabetes Mellitus

- Clinical Suspicion
  - Increased Thirst, Urination, Drinking
  - Nighttime Urination/Bedwetting
  - Increased Eating, Weight Loss
  - Nausea/Vomiting +/-
  - Family History

Kidney Threshold for Glucose!!
Diabetes:
Stress and Illness
• Psychological, Emotional, and Physical stress induces ↑ blood sugar production and insulin resistance
• If not eating, the body can produce and release limited amounts of blood sugar from storage
• Vomiting and diarrhea increase risk of dehydration
• Prolonged fasting or lack of sufficient insulin leads to ketone production
• Ketones???
  – Just an alternate (and less effective) energy source
Type 1 Diabetes: Management

There are so many people out there who will tell you that you can’t. What you’ve got to do is turn around and say “Watch me.”
Diabetes Team Management

• Requires
  – Diabetes Education
  – Nutrition Education
  – Social Services Support
  – Public Health Services
  – School Support Services
  – Glucose Monitoring
  – Insulin Management
**Therapeutic Goals (T1DM)**

<table>
<thead>
<tr>
<th>Plasma blood glucose range (mg/dl)</th>
<th>Before meals</th>
<th>Bedtime/Overnight</th>
<th>A1c</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toddlers and preschoolers (0-6)</td>
<td>100-180</td>
<td>110-200</td>
<td>&lt;8.5% (but &gt;7.5%)</td>
</tr>
<tr>
<td>School Age (6-12)</td>
<td>90-180</td>
<td>100-180</td>
<td>&lt;8%</td>
</tr>
<tr>
<td>Adolescents and young adults (13-19)</td>
<td>90-130</td>
<td>90-150</td>
<td>&lt;7.5%</td>
</tr>
</tbody>
</table>

Type 1 Diabetes: Tools of the Trade
Glucose Monitoring

I'm the Blood Sugar Fairy. If you can see me, yours is too low.

Wendy L. Novak
Diabetes Care Center
Treatment

• “Patient-Centered” Approach
  – Subcutaneous Insulin
  – Continuous Subcutaneous Insulin Infusion Pump
  – Adjunct Agents
Insulin Forms and Profiles

- Basic Injection Plan
- Multiple Daily Injection Plan

Insulin Aspart (NovoLog®)
- Insulin Lispro (Humalog®)
- Insulin Glargine (Lantus®)
- Insulin Detemir (Levemir®)
- Insulin Glulisine (Apidra®)

Wendy L. Novak
Diabetes Care Center
• Short-Acting Insulin Analogs

• Long-Acting Analogs
Insulin Pumps

- How Does It Work
  - The pump is programmed
  - Components: PDA (meter), reservoir, tube (+/-) and set
  - Insulin (fast-acting analogs)
    - **Basal** = Continuous pulses of "background" insulin
    - **Bolus** = Larger doses given based on glucose level and/or carbs counted
  - The pump is worn 24/7 - only detached for special circumstances
• Head to Head
  – Pancreas
  – Insulin Pump
Insulin Pumps
Insulin Pumps

Using the Bolus Wizard Feature

To Deliver a Food and Correction Bolus:
1. Press \(\text{g}1\). Test BG. If using linked meter press \(\text{g}2\). Or, use arrows to enter BG. Press \(\text{g}3\).
2. Use \(\text{g}4\) to enter grams of carb. Press \(\text{g}5\).
3. Review details. Press \(\text{g}6\).
4. Confirm bolus amount (change if necessary). Press \(\text{g}7\) to deliver.

To Deliver a Correction Bolus (no food):
1. Press \(\text{g}8\). Test BG. If using linked meter press \(\text{g}9\). Or, use arrows to enter BG. Press \(\text{g}10\).
2. Leave grams of carbohydrates at zero. Press \(\text{g}11\).
3. Review details. Press \(\text{g}12\).
4. Confirm bolus amount (change if necessary). Press \(\text{g}13\) to deliver.

To Deliver a Food Bolus (no BG):
1. Press \(\text{g}14\). Leave the Enter BG screen as dashes. Press \(\text{g}15\).
2. Use \(\text{g}16\) to enter grams of carb. Press \(\text{g}17\).
3. Review details. Press \(\text{g}18\).
4. Confirm bolus amount (change if necessary). Press \(\text{g}19\) to deliver.

To Review Bolus History:
1. Press \(\text{g}20\). Select Bolus. Press \(\text{g}21\).
2. Select Bolus History. Press \(\text{g}22\).
3. Use arrows to review boluses given.

To Edit Bolus Wizard Settings:
1. Press \(\text{g}23\). Select Bolus. Press \(\text{g}24\).
2. Scroll to Bolus Setup. Press \(\text{g}25\).
3. Highlight Bolus Wizard Setup. Press \(\text{g}26\).
4. Highlight Edit Settings. Press \(\text{g}27\).
5. Select the setting to be changed. Press \(\text{g}28\).
6. Change value. Press \(\text{g}29\).

To Review Bolus Wizard Settings:
1. Press \(\text{g}30\). Select Bolus. Press \(\text{g}31\).
2. Scroll to Bolus Setup. Press \(\text{g}32\).
3. Highlight Bolus Wizard Setup. Press \(\text{g}33\).
4. Highlight Review Settings. Press \(\text{g}34\).
5. Scroll down to review.

Note: The settings shown are for illustration purposes only — your settings will be different.
Dietary Treatment

• Focused Diet
  – “No sugar, No concentrated sweets”
  – Carbohydrate monitoring

• Support
  – Family
  – Friends
  – School

“Which is more evil...Darth Vader, The Joker, Frankenstein, sugar, fat or carbs?”
• Calculate Glucose Correction Factor
  – Estimation of # of mg/dl reduction in blood glucose from 1 unit of insulin

Utilize Glucose Correction Factor at meals and for random hyperglycemia correction.

Example: Correction factor = 1 unit : 50 mg/dl
If glucose is 250 mg/dl (target = 100 mg/dl) = 3 units
• Nutrition/Diabetes Educator Counseling
• Calculate Insulin: Carbohydrate ratio (I:CHO)
  – Estimation of # of grams that 1 unit will cover
• Estimate grams of Carbohydrates with meal

  Utilize the I:CHO ratio for meal coverage
  Example: 1 unit:15 grams if eating 60 gram meal = 4 units
Our Role

• Supporting the Child (Student) and Family
  – Trust
  – Fear
  – Hope
  – Medical Need
  – Financial Need
  – Empowerment
School Plan

• Developing a Health Plan
  – Principal
  – Teachers
  – Designated child health advocate
    • Public Health Nurse
    • School nurse
    • Office personnel
    • School teacher
  – Cafeteria personnel

• Identify impact of diabetes on performance/development
School Plan

• Blood Glucose Monitoring
  – Location
    • Office
    • Teacher/Student***
  – Frequency
    • Before meals
    • +/- P.E. class
    • Bus ride
School Plan

• **Meal Plan**
  – No concentrated sweets!!!
  – Carbohydrate counting
    • Packed Lunch/Snack
      – Carb count written on bag
    • School Lunch/Snack
      – School provides detailed menu
      – Parent/Child/School Personnel estimate count prior to eating
Type 1 Diabetes: 
School Management

“There aren’t any icons to click. It’s a chalk board.”
Little Jay is a 6 yo boy in school

- His mommy gave him a mixed dose of NPH and Novolog insulin at breakfast

- He has a bagged lunch with 52 grams (he is supposed to eat ~ 45g)

- He checks his blood sugar and it's 212 mg/dl

Action:
- Record blood sugar
- Send him to lunch

Plasma Insulin

Breakfast

Dinner

Snack

NPH

Analog

NPH

Analog
• Little Jay is a 6-yr-old in school.
  – He has a URI but feels "good."
  – He has a bagged lunch with 52 grams.
  – He checks his blood sugar and it's 312 mg/dl.

Action (Depends on School Plan):
• Record blood sugar.
• ? Check for urine ketones = small ketones.
• Possible small Novolog dose to "clear" ketones and/or call parents.
• Bret is a 15 yo boy in school (MDI Plan)
  – He looks at his bagged lunch and is going to eat 62 grams of Carbs
    • His Insulin to Carb ratio = 1 unit : 15 grams
      – If eating 62 gram meal ~ 4 units
  – He check his blood sugar - 242 mg/dl
    • His Correction factor = 1 unit : 50 mg/dl
      – If glucose is 242 mg/dl (target = 100 mg/dl) ~ 3 units
  – TOTAL Novolog Dose = 4 + 3 = 7u
• Bret is a 15 yo boy in school (MDI Plan)
  – TOTAL Novolog Dose = 4 + 3 = **7u**
  – Action:
    • Record blood sugar
    • Attach new pen needle to pen
    • Visually monitor injection
• Bret is a 15 yo boy in school (MDI Plan)
  – He says he is not hungry and will not eat
  – He checks his blood sugar (242 mg/dl)
    • His Correction factor = 1 unit : 50 mg/dl
    – If glucose is 242 mg/dl (target = 100 mg/dl) ~ 3 units
  – TOTAL Novolog Dose = 3u
  – Action:
    • Record blood sugar and monitor injection
    • Send Bret to lunch room
    • Tell him to come back if he eats
Halle is a 15 yo girl in school (Insulin Pump)
  – She looks at her lunch menu and decides to eat 62 grams of Carbs
    • Her Insulin to Carb ratio = 1 unit : 12 grams
      – If eating 62 gram meal = 5.15 units
  – She checks her blood sugar and its 182 mg/dl
    • Her Correction factor = 1 unit : 35 mg/dl
      = 2.35 units
Halle is a 15 yo girl in school (Insulin Pump)

- TOTAL Novolog/Humalog Dose
  \[ = 5.15 \text{u} + 2.35 \text{u} = 7.5 \text{u} \]

- Action
  - Record blood sugar
  - Visually monitor bolus into pump
  - Send Halle to lunch
Halle is a 15 yo girl in school (Insulin Pump)
- She is complaining of nausea and "belly" pain
- She checks her blood sugar and it's 582 mg/dl
- You suspect possible pump occlusion

Action
- Record blood sugar
- Check urine ketones = large
- Contact her mother
- Discuss giving subq Novolog injection with syringe or pen with Diabetes Educator
Type 2 Diabetes: The “Newest” Form of Diabetes in Children

"Your blood sugar is too high."
Cause and Effect

- Genetics
- Environment
- Lifestyle

“When I hit 120 years, I developed adult-onset diabetes.”
• Clinical Suspicion
  – Polyuria, Polydipsia, Polyphagia
  – Nocturia, Nocturnal Enuresis
  – Acanthosis Nigricans
  – Overweight or Obese
  – Family History!!!
Type 2 Diabetes: Treatment

“Eat less and exercise more? That’s the most ridiculous fad diet I’ve heard of yet!”
Type 2 Diabetes Mellitus

- Treatment
  - Nutrition/Dietary Counseling
  - Exercise Counseling
  - Blood Glucose Monitoring
  - Medication Therapy
• Blood Glucose Monitoring
  – Patient Specific
    • Fasting; 2hr post-prandial
    • Standard basal-bolus monitoring
• Medication Treatment modalities
  – Oral Medication (Metformin)
  – Oral Medication + Insulin Therapy
  – Insulin Therapy
  – Injectable Glucose Lowering Agents
Diabetes: Clinical Support
Clinic Management

• Appointments:
  – MD/NP visits – at diagnosis, then q3 months
  – Nutrition visits – at diagnosis, then annual or prn for management changes
  – Diabetes Educator – at diagnosis, then annual or prn for management changes

• Phone:
  – Diabetes Educators – available 9-5pm, Mon-Fri
  – MD – on-call 24 hrs, 7 days a week
Thank You

Diabetes Care and Education Team
- Michael Foster, MD
- Kupper Wintergerst, MD
- Adetokunbo Omoruyi, MD
- Suzanne Kingery, MD
- Kellie Woodruff, APRN
- Stacy McCauley, APRN
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