Outreach Education

Diabetes Update: Management of the Pediatric Population

Erin Alving, ARNP, CDE

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Program Handouts

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Diabetes Update: Management of the Pediatric Population

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Objectives

- Review Pathophysiology
- Discuss the recommended goals for glycemic control throughout childhood
- Discuss common developmental issues and their impact on diabetes self management in children and teens
- Review of technology and insulins used in the management of diabetes in children and adolescents
- Answer Questions

Definition

- Diabetes Mellitus is a chronic disorder in which the body cannot properly utilize glucose
- Glucose is the principal fuel of the body
- Diabetes: “to go through”
- Mellitus “honey”

Total number of people in the US with diabetes: 23.6 million (8% of the population)
5.7 million are undiagnosed
57 million people have pre-diabetes
There are 186,300 people under age 20 with diabetes (about 0.22% of people in this age group)
One in every 400-600 children and teens have type 1 DM

Washington State

- 6.5% of Washington state adults have diabetes, up from 4.1% in 1994
- 2,500 people per year in Washington are hospitalized with DKA (41 per 100,000)
- Little data for the pediatric population

Seattle Children’s Division of Endocrinology

- Incidence has increased from 40 per year in 1994 to 191 new onsets in 2008.
- Increasing numbers with type 2 diabetes.
**Children’s New Patients**

![Graph showing children's new patients over the years.]

**Children’s Newly Diagnosed Patients**

![Graph showing new patients diagnosed over the years.]

**All Patients Seen in Outpatient Clinic**

![Graph showing clinic patients by age.]

**Diabetes Patient Demographics at Children’s FY 2008**

- 1288 Clinic Patients
- 6485 Visits
- 94% Type 1

**FY 2007 Comparison Data:**

- 1156 Clinic Patients (+11%)
- 5953 Visits (+9%)
- 95% Type 1

**Hgb A1C Trends**

<table>
<thead>
<tr>
<th>Age Group</th>
<th>HbA1c - FY2007</th>
<th>HbA1c - FY2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-3</td>
<td>8.91</td>
<td>8.61</td>
</tr>
<tr>
<td>4-5</td>
<td>8.15</td>
<td>8.91</td>
</tr>
<tr>
<td>6-12</td>
<td>8.13</td>
<td>8.18</td>
</tr>
<tr>
<td>13+</td>
<td>8.66</td>
<td>6.12</td>
</tr>
<tr>
<td>Overall</td>
<td>8.37</td>
<td>8.57</td>
</tr>
</tbody>
</table>

**High Risk Patients at Children’s**

<table>
<thead>
<tr>
<th>Hba1c</th>
<th># of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;=10%</td>
<td>15.7% 14.2%</td>
</tr>
<tr>
<td>&gt;=14%</td>
<td>1.4%  3.5%</td>
</tr>
</tbody>
</table>
Classification

- **Type 1**
  - Insulin deficient
  - Ketosis prone
  - Under 30 years of age
  - Thin
  - 90% with negative family history

- **Type 2**
  - Insulin resistant
  - No ketosis
  - Typically over 40 years of age
  - Overweight
  - Strong family history

Types of Diabetes Mellitus

- Hybrid Type
- Mature Onset Diabetes of Youth (MODY)
- Neonatal Diabetes
- Latent Autoimmune Diabetes of the Adult (LADA)
- Medication induced (L-asparaginase, high dose steroids)
- Cystic Fibrosis related
- Pregnancy induced

Natural History of Type 1 Diabetes

- Cellular (T cell) Autoimmunity
  - Loss of first phase insulin response (IVGTT)
  - Glucose intolerance (OGTT)

- Humoral Autoantibodies (ICA, IAA, Anti-GAD65, IA, IA2, Ab, etc.)

- Putative Environmental Trigger

- Clinical Onset

- Beta cell mass

- Diabetes

Clinical Presentation

- Polyuria, polydipsia, and polyphagia
- Weight loss
- Enuresis, nocturia
- Recurrent infection, vaginal candidiasis
- Ketonuria

Clinical Presentation: Diabetic Ketoacidosis (DKA)

- All of the previous symptoms and:
- Nausea/Vomiting
- Dehydration
- Kussmaul respirations
- Ketone/acetone breath
- Fatigue/weakness/lethargy; can lead to obtundation
- Life threatening!

Recurrent DKA

- Insulin omission
- Illness
- Preventable
Pathophysiology of Type 2 DM

- Insulin resistance
  - Insulin production is normal or increased
- Genetics
  - There is a stronger inherited risk than type 1
  - Most have a first degree relative with type 2 DM
- Lifestyle
  - Obesity is the most prominent clinical risk factor; 80% are overweight.

Pathophysiology of Type 2 DM

- Islet Cell antibodies are not present
- Rates are higher in people of Hispanic, Native-American, or African-American heritage
- Increasing incidence in the pediatric population

Clinical Presentation Type 2 DM

- May go undetected for months or years
- Obesity
- Acanthosis Nigricans
- Polyuria, polydipsia, polyphasia may be absent or mild
- Acute illness may bring on “classic” symptoms of diabetes

Clinical Presentation Type 2 DM

- Glycosuria may be detected during a routine check up
- Fatigue
- Blurred vision
- Possible weight loss
- Vaginal candidiasis
- Hypertension and dyslipidemia possible

Diabetes in Childhood
ADA recommendations for screening for type 2 DM in children

- Overweight (BMI >85th percentile for age and sex, weight for height >85th percentile, or weight >120% of ideal for height)
  - Plus any 2 of the following risk factors:
    - Family history of type 2 DM in 1st or 2nd degree relative
    - Race/ethnicity
    - Signs of insulin resistance or conditions associated with insulin resistance (acanthosis nigricans, hypertension, dyslipidemia)

ADA recommendations for screening for type 2 DM in children

- Age of initiation: 10 years old or at onset of puberty
- Frequency: every 2 years
- Test: Fasting plasma glucose

Criteria for Diagnosis of Type 2 DM

<table>
<thead>
<tr>
<th>Normal Blood Glucose</th>
<th>IFG or IGT</th>
<th>Diabetes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fasting (8 hours)</td>
<td>&lt;100 mg/dl</td>
<td>≥100 and &lt;126 mg/dl</td>
</tr>
<tr>
<td>Two hours after glucose or casual BG</td>
<td>&lt;140 mg/dl</td>
<td>≥140 and &lt;200 mg/dl</td>
</tr>
</tbody>
</table>

Management of Diabetes

- Goal is to diminish and/or prevent the occurrence of the long term complications of diabetes while promoting a favorable quality of life

The Diabetes Control and Complications Trial Applied to Pediatrics

- <2 years of age: tight control is contraindicated
- 2-7 years: use extreme caution
- Pre-adolescent: tighten control but not to adult recommendations
- Adolescent: goal is the same as that achieved in the DCCT

Goals for Glycemic Control Throughout Childhood

- < 6 years old: BG 100-180, Hgb A1C 7.5%-8.5%
- 6-12 years old: BG 90-180, Hgb A1C <8%
- 13-19 years old: 90-130, Hgb A1C <7.5%
- Late adolescence/adulthood: Hgb A1C <7

Diabetes in Childhood
Management of DM

- For Type 1 and 2 recommend:
  - Checking blood glucose at least 4 times per day; before meals and at bedtime with a record kept in a log book format (may use download of pump or meter)
  - Dietary management/carb counting
  - Regular activity
  - Patient and parent use of technology
  - Quarterly visits with a multidisciplinary diabetes team

- Dietary management/carb counting

- Regular activity

- Patient and parent use of technology

- Quarterly visits with a multidisciplinary diabetes team

Management of type 2 DM

- Insulin often needed initially to correct acute hyperglycemia
- Combination of insulin and oral agents
- Weaning of insulin to oral agents alone
- Nutrition counseling
- Physical activity
- Continuous education
- Emotional support
- May not check blood glucose as often as Type 1 if not taking insulin

The Diabetes Care Team

- Participation of a multidisciplinary team is imperative to maintaining good control
  - Endocrinologist/Nurse Practitioner/Physician Assistant
  - Certified Diabetes Nurse Educator
  - Dietician
  - Social Worker
  - Psychosocial Nurse Practitioner/Psychologist
  - Child Life Specialist

Community

- Primary Care Provider
- School nurse
- Pharmacist
- Support groups
- Conferences
- Organizations
  - ADA
  - JDRF

Follow-up

- New onset within 2-3 weeks of discharge from the hospital with MD or NP or PA, CDE, dietician, and social worker
- Every 3 months thereafter with provider
- Annual visit with the diabetes team
- Patients should continue to see their primary care provider for all other care

Routine Laboratory Studies and Screening

- Hgb A1C each visit
- Yearly screening
  - Urine microalbumin/creatinine ratio
  - Thyroid function tests
  - Eye exam by an ophthalmologist starting 5 years after diagnosis or in adolescence, whichever comes first
  - Lipid panel
  - Celiac Disease

Diabetes in Childhood
Developmental Considerations in the Management of Diabetes

Infants and Toddlers
- Time of rapid brain and motor development
- Infants are developing trust
- Holding and cuddling are important
- Parents may feel guilty giving injections and poking fingers to test blood
- Parents need reassurance

Infants and Toddlers: Tasks related to Diabetes
- BG testing
  - May use toes
  - Frequent testing
- BG levels
  - Avoiding lows is a priority
  - Range 80-200 mg/dl
- Injections
  - Buttocks often best choice

Preschool and Early School Age
- Concrete thinkers
- Begin to see self as individual
- Self centered
- Responsibilities increase in the 5-7 age range
- Begin to read

Preschool and Early School Age: Tasks Related to Diabetes
- Parents are still responsible for all tasks
- Learning to cooperate
- Help by choosing finger to poke or site for injection
- Begin to recognize symptoms of hypoglycemia
- Begin to learn about which foods have carbohydrates

Michael
- 6 year old male with 2 year history type 1 diabetes
- Hgb A1C 7.6
- Michael does own finger pokes and some injections
- Parents give injections and count carbohydrates
- Parent designated adult or school nurse helps with injections at school
Michael
- Assessment: diabetes that is well controlled
- Plan: continue to encourage Michael’s participation in self-care as he is ready. Parents continue to be in charge of all of the diabetes management

School Age
- Concrete thinkers
- Fairness is important
- Develop friendships with peers, more social
- Can take on more responsibility
- Able to participate in food preparation

School Age: Tasks Related to Diabetes
- Begin testing own blood glucose
- Begin measuring and giving own injections
- May feel “it’s not fair”
- Able to recognize and take steps to treat hypoglycemia
- More aware of time; remember to eat snacks
- More understanding of diet

Alicia
- 11 yo girl with 4 year history type 1 diabetes presented to CHRMC in DKA.
- Over the past year HgbA1C has ranged from 8.1 to 9.2.
- Consistent follow up appointments every 3 months
- Historically tested blood glucose 4 or more times per day
- What happened?!

Alicia
- Alicia had begun giving her own injections for several months
- Alicia was testing independently and informing her parents if the readings were out of range
- Alicia spent the night and following day at her grandmother’s house where she became ill
- Grandmother and Alicia did not know about DKA
**Teenager**

- Developing independence and own identity
- Skills and responsibilities increase (driving a car for example)
- Keen awareness of body image
- Spends more time with friends and away from home
- Experimentation with alcohol common

(H. P. Chase, 2002)

**Teenager: Tasks Related to Diabetes**

- Responsible for most of diabetes care
- Safety concerns related to driving
- Experimentation with alcohol or recreational drugs can affect glycemic control
- Parents need to stay involved
- Begin transition to adult diabetes team in late adolescence

(H. P. Chase, 2002)

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**Danny**

- 17 year old male diagnosed with type 1 diabetes at 9 years of age
- Hgb A1C 12.4
- Poor control for many years
- Avid skateboarder. Involved in Young Life. Works bagging groceries after school. Taking advanced placement classes
- Two household family. Lives with father most of the time

**Assessment**

- Highly suspect some of the readings are falsified (Danny denies this)
- Missed prandial injections
- Poor glycemic control

**Plan**

- Danny to review blood sugars with father every 2 to 3 days
- Danny set goal of injecting with every meal and snack
- Social work visit at next follow up in 6 weeks

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**Teen Transition Program**

- Diabetes Passport
- Transition “event” (Panel of experts) – April 11, 2009
- Transition clinic coming
Insulin Actions

<table>
<thead>
<tr>
<th>Type of Insulin</th>
<th>Begins Working</th>
<th>Main Effect</th>
<th>All Gone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short-Acting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulin lispro (Humalog)</td>
<td>10-15 minutes</td>
<td>3-4 hours</td>
<td></td>
</tr>
<tr>
<td>Insulin aspart (Novolog)</td>
<td>10-15 minutes</td>
<td>3-4 hours</td>
<td></td>
</tr>
<tr>
<td>Insulin glulisine (Apidra)</td>
<td>10-15 minutes</td>
<td>3-4 hours</td>
<td></td>
</tr>
<tr>
<td>Regular</td>
<td>3-50 minutes</td>
<td>2-4 hours</td>
<td>6-9 hours</td>
</tr>
<tr>
<td>Intermediate-Acting</td>
<td>1-2 hours</td>
<td>3-8 hours</td>
<td>12-15 hours</td>
</tr>
<tr>
<td>Long-Acting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulin glargine (Lantus)</td>
<td>1-2 hours</td>
<td>24 hours</td>
<td></td>
</tr>
<tr>
<td>Insulin detemir (Levemir)</td>
<td>1-2 hours</td>
<td>20 hours</td>
<td></td>
</tr>
</tbody>
</table>

(Chase, P., 2006)

Figure 1: Use of Lantus Insulin

Two of the most common methods of using Lantus insulin:

In the first example, Lantus is used to control insulin and Humalog (B) or Novolog (A) is taken prior to meals.

In the second example, NPH and Humalog (B) or Novolog are taken in one syringe in the a.m. Humalog is taken at dinner. Lantus (alone in the syringe) is taken either at bedtime or in the e.a. or in the a.m.

(Chase, 2002)
“Rapid-acting insulin is used in the pump
- Humalog
- Novolog
- Apidra
Insulin is delivered in two ways
- Basal rate
- Boluses
Several days’ worth of insulin is stored in the pump reservoir
- The infusion set and reservoir are changed every 3 days

Advantages of Pumps
- Improved glycemic control
- Ease of insulin delivery (no daily injections!)
- Flexibility
- Less glycemic excursion
- More efficient delivery and use of insulin
Disadvantages of Pumps

- Increase risk of ketosis
- Weight gain
- Body image
- Skin infections
- Always attached to the pump
- Possibly more work compared to injections

Who Should Pump?

- Ideally the child should be developmentally able to manage the pump independently
- Those who are managing their diabetes well are most likely to do well with CSII
- Pump protocol makes sure it is a good match
- The pump is not the “magic” answer

Animas IR 1200

MiniMed Paradigm

Mini Link Real Time Sensor

DexCom STS
Treating lows

- If mild s/sx and bg < 60-70 (depending on age) give 8 oz milk or 4 oz juice or sugar soda. Wait 10 minutes then eat snack with carbs and protein.
- If mild s/sx and bg > 60-70 eat solids (crackers, fruit, etc)

(Chase, H. P., 2002)

Treating Lows

- If moderate (not alert) give glucose gel, juice, sugar, or other rapid acting carb. Repeat bg in 10 minutes. Once > 60-70, eat solids.
- If severe (unconscious or seizing) give glucagon IM or SQ. Dose: <6yrs 0.3 cc, 6-18 yrs 0.5cc, >18 yrs 1cc. Recheck bg in 10 minutes. Give sips sugar containing liquids or glucose gel once awake. Call 911 if not responding, difficulty breathing.

(Chase, H. P., 2002)

Mini Dose Glucagon

- For low blood glucose management during vomiting illness if no ketones
  - Mix glucagon as instructed
  - Give 1 “unit” sq using insulin syringe per year of age, up to a maximum of 15.
  - Can be repeated in 20-30 minutes if BG is not coming up

(Chase, H. P., 2002)

Treating Highs

- Encourage the child to drink plenty of fluids, preferably water
- If BG > 250 for 2 tests in a row, check urine ketones
- For any child using an insulin pump, if any bg is >300, check ketones
- Give insulin if indicated

Review of School Forms
The Good News

- Advances in biotechnology and knowledge about diabetes allow continued improvements in glycemic control and quality of life. Expect the occurrence of the long-term complications of diabetes to diminish in coming years.

Websites

- American Diabetes Association [www.diabetes.org](http://www.diabetes.org)
- Barbara Davis Center [www.ucdsc.edu/misc/diabetes/index.html](http://www.ucdsc.edu/misc/diabetes/index.html)
- [www.childrenwithdiabetes.com](http://www.childrenwithdiabetes.com)
- International Society for Pediatric and Adolescent Diabetes [www.ispad.org](http://www.ispad.org)
- Juvenile Diabetes Research Foundation [www.jdrf.org](http://www.jdrf.org)

References

American Diabetes Association, [www.diabetes.org](http://www.diabetes.org)

Guidelines of care for management of diabetic ketoacidosis, Children’s Hospital and Regional Medical Center, Seattle, WA. 2001