**Alteration in Endocrine Dysfunction**

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**Precocious puberty**
- Girls: breast development with growth of pubic hair before age 8
- Boys: testicular growth greater than 3 cm diameter with development of pubic hair before age 9
- Premature skeletal maturation

*No causative factor can be found in 80% -90% of girls and in 50% of boys with the condition*

**Diagnosis/ pathophysiology**
- LH secreted by pituitary in response to Gonadotrophin-releasing hormone from the hypothalamus
- Early secretion of the normal hormones responsible for pubertal changes is not usually associated with abnormalities
- A benign hypothalamic tumor may be present.

**Treatment of precocious puberty**
- Management focuses on altering hormonal balance
- Leuprolide (luteinizing hormone-releasing factor) administered monthly im or daily sc injection
- Counseling for psychological adjustment

**Growth Hormone Deficiency**
- AKA somatotropin
- Disorder of Pituitary Gland
- Can be congenital or acquired
- Also have episodes of hypoglycemia, particularly in infancy, which resolve with GH therapy
- Can occur in combination with other pituitary hormones
  - Thyroid stimulating hormone
  - Luteinizing hormone,
  - Follicle-stimulating hormone
  - Adrenocorticotropic hormone
  - prolactin

**Influences of height**
- Height of Parents
  - Find the mid parental height, "target height"
  - (mother +5 inches) +father’s height /2 for boy
  - (Father – 5 inches) + mother’s height/2 for girl
  - Represents the statistically most probable adult height for the child
- Timing of puberty in parents
- Constitutional growth delay
- Previous growth points
- Growth pattern ( should be 2 inches per year)
- General Health of child
- Nutrition History
Causes of short stature

- Most cases of GHD are idiopathic
- Organic
  - Brain tumors
  - CNS surgery
  - CNS radiation
  - Anatomic abnormalities
- Genetic GHD
- Infarction of the pituitary gland related to sickle cell disease
- Psychosocial deprivation by interfering with the production or release of growth hormone

Clinical Manifestations

- Normal birth weight and height
- Age 1, below the 3rd percentile for height
- Slow growth < 2 inches per year
- Hypoglycemic seizures
- Hyponatremia
- Neonatal jaundice
- Pale optic discs
- Micropenis
- Undescended testes
- Appear "cherubic" with youthful features
- High pitched voice
- Delayed dentition

<table>
<thead>
<tr>
<th>TEST</th>
<th>PURPOSE RELATED TO SHORT STATURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>IGF-1</td>
<td>Excludes growth hormone if normal</td>
</tr>
<tr>
<td>Xray/ MRI of sella turcica (site of pituitary gland)</td>
<td>Demonstrates size of the sella turcica or a tumor</td>
</tr>
<tr>
<td>Karyotype</td>
<td>Detects Turner syndrome</td>
</tr>
<tr>
<td>Thyroid function studies</td>
<td>Detects hypothyroidism</td>
</tr>
<tr>
<td>Urine creatinine, pH, specific gravity electrolytes</td>
<td>Detects chronic renal failure</td>
</tr>
<tr>
<td>Bone age</td>
<td>Identifies other potential causes of delayed growth</td>
</tr>
<tr>
<td>CBC</td>
<td>Screens for inflammatory bowel disease</td>
</tr>
<tr>
<td>Antigliadin antibodies</td>
<td>Screens for celiac disease</td>
</tr>
</tbody>
</table>

Clinical Therapy

- Replace with growth hormone IM
- Initially child grows at increased velocity for first year, then slows
- Growth should progress at least at the normal growth rate for age.
- Continued therapy until either the child achieves an acceptable height or growth slows to less than 1 inch per year.
- Humatrope pen [www.humatrope.com](http://www.humatrope.com)

Side effects of growth hormone

- Arthralgia
- Carpal tunnel
- Myalgia
- Reduced insulin
- SLIPPED CAPITAL EPIPHYSIS
- Gynecomastia
- Progression of scoliosis
- Headaches

Type I Diabetes

- The majority of children with diabetes have immune-mediated type 1.
- Results from destruction of pancreatic islet beta cells
10/6/2007

Type 1 Diabetes
IDDM
Juvenile Onset Diabetes
• Combination of a viral infection and an autoimmune reaction
  – Genetic Factors: little agreement about the exact mode of transmission
  – Anti-islet antibodies are detected in a number of unaffected first degree relatives of children with IDDM.

IDDM (pathophysiology)
• Insulin works by facilitating the entry of Carbohydrates, Fats and Proteins into the cells
  – insulin is needed for the entry of glucose into the muscle and fat cells,
  – Prevention of mobilization of fats from fat cells
  – storage of glucose as glycogen in the cells of the liver and muscle

Insulin is necessary for glucose to enter cells

Clinical Presentation of Diabetes in children

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Prevalence in Type I diabetes</th>
<th>Prevalence in Type II diabetes</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAMILY HISTORY</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>MINORITY</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>OVERWEIGHT</td>
<td>Low</td>
<td>Very High</td>
</tr>
<tr>
<td>RECENT WEIGHT LOSS</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>POLYPHAGIA, POLYDIPSIA, POLYURIA</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>KETOACIDOSIS</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>HYPERTENSION</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>DYSURIA</td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>

Symptoms of diabetes
• excessive thirst
• excessive urination
• excessive hunger
• weight loss
• fatigue
• blurred vision
• high blood sugar level
• sugar and ketones in the urine
Clinical Manifestations of Diabetes by Type

<table>
<thead>
<tr>
<th>Type 1</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptoms</td>
<td></td>
</tr>
<tr>
<td>Polyuria</td>
<td>Polyuria</td>
</tr>
<tr>
<td>Polydipsia</td>
<td>Polydipsia</td>
</tr>
<tr>
<td>Polyphasia</td>
<td>Polyphasia</td>
</tr>
<tr>
<td>Weight loss</td>
<td>Weight loss</td>
</tr>
<tr>
<td>Nephropathy</td>
<td>Nephropathy</td>
</tr>
<tr>
<td>Angiopathy</td>
<td>Angiopathy</td>
</tr>
<tr>
<td>Neuropathy</td>
<td>Neuropathy</td>
</tr>
</tbody>
</table>

CLINICAL MANIFESTATIONS

- Polyuria r/t increase glucose in urine
- Polydipsia r/t urinary fluid loss
- Polyphasia r/t "starvation"

Diagnosis is often missed or delayed because IDDM mimics other diseases – appendicitis, flu, gastroenteritis

Lab studies
- Urine glucose: + urine glucose suggests, but is not diagnostic for IDDM. Test urine for ketones at time of diagnosis
- Urine Ketones: Ketones in the urine confirm lipolysis and gluconeogenesis, which are normal during periods of starvation. With hyperglycemia and glycosuria, ketonuria is a marker of insulin deficiency and potential DKA
- Blood glucose: Random BG > 200 is diagnostic for diabetes, Fasting BG > 126
- Glycosylated Hemoglobin: HbA1c Average blood-glucose concentrations over an 8-10 week period. 7.9% (book says 7.5-8)

Partnering with Families

Recognizing Signs of DKA

- Vomiting more than twice in a 24 hour period
- More than 4 clear stools in 24 hours
- Profuse, sweet-smelling breath
- Altered mental status
- Temperature over 101°F (38°C) for 24 hours
- Blood glucose > 400 mg/dl on two separate readings, or > 200 mg/dl and mandate to large ketones
- Large ketones on strip, or acetone breath
- Evidence of bacterial infection (i.e., peritonitis, sepsis)
- Difficulty breathing
- Changes in mental status
- Diabetic coma or other evidence of urinary tract infection

Ketoacidosis

- Blood sugar >300
- Ketonemia
- Acidosis
- Bicarbonate

Treatment of Ketoacidosis

- IV fluids (all patients suffer dehydration up to 10% of BW)
- Volume expansion with isotonic saline
- Insulin 1 u/kg/hr to BS < 200
- Glucose/calories to reverse intracellular starvation
- Replace lost electrolytes
- Place on cardiac monitor
Prevent Complications of Ketoacidosis

- Shock
- renal failure
- hypoxia
- thrombosis
- dehydration
- electrolyte imbalance
- acidosis
- Cerebral edema
- hypoglycemia
- hypoxia
- coma
- death
- underlying infection

Blood Glucose Testing

Goals for Blood Glucose

<table>
<thead>
<tr>
<th>Goal</th>
<th>Ideal</th>
<th>Acceptable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before breakfast</td>
<td>70-110</td>
<td>60-120</td>
</tr>
<tr>
<td>Before lunch</td>
<td>70-130</td>
<td>60-150</td>
</tr>
<tr>
<td>1 hr. after meals</td>
<td>&lt;180</td>
<td>&lt;200</td>
</tr>
<tr>
<td>2 hrs. after meals</td>
<td>&lt;150</td>
<td>&lt;180</td>
</tr>
<tr>
<td>3 hrs. after meals</td>
<td>&lt;120</td>
<td>&lt;150</td>
</tr>
<tr>
<td>2 am- 4 am</td>
<td>&gt;70</td>
<td>&gt;70</td>
</tr>
</tbody>
</table>

Insulin therapy

- Twice-daily combinations of short- and intermediate-acting insulin
- **BASAL BOLUS REGIMEN** Multiple injection regimens, using once- or twice-daily injections of long- or intermediate-acting insulin and short-acting insulin given at meals
- A combination of the above 2 regimens, with a morning injection of mixed insulin, an afternoon premeal injection of short-acting insulin and an evening injection of intermediate- or long-acting insulin
- Continuous subcutaneous insulin infusion (CSII) using an insulin pump

Basal Bolus therapy

- Monitor blood glucose 4-8 times per day and once a week at midnight and 3 am
- Consistent carbohydrate counting
- Anticipating exercise in the routine
Insulin Peak Times: 3 Injections/day

Teaching tool for insulin action times

Problems in pediatric diabetes

- Sick days
- Growth hormone secretion
- Honeymoon phase
- Monitor for complications
  - Hyperglycemia
  - Hypoglycemia
  - DKA
  - Injection-site hypertrophy
  - Diabetic retinopathy
  - Diabetic neuropathy and hypertension
  - Proteinuria
- Medicalert bracelet

Nutrition

- Provide adequate calories for normal growth and development
- Carbohydrate counting
  - 1 unit of insulin for every 8 gms of carbohydrate
  - 1 carbohydrate choice is 15 gms of carbohydrate
- Younger school age get 2-4 carbohydrate choices per meal
- Older school age and adolescents get 4-6 carbohydrate choices per meal

Nutrition

BOX 32-9 Sick Day Guidelines

When the child with diabetes is sick, the following rules apply.

- Seek medical attention for fever or other signs of infection.
- Monitor the serum glucose levels more often than routine.
- The required dose of insulin may be increased.
- Do not skip doses of insulin.
- Continue to maintain food and fluid intake.
- Monitor urine for ketones.
10/6/2007

Examples of blood glucose

- [www.sugarstats.com](http://www.sugarstats.com)

<table>
<thead>
<tr>
<th>Time</th>
<th>Blood sugar</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>6:00</td>
<td>343</td>
<td></td>
</tr>
</tbody>
</table>

Exercise

- Reduces the need for insulin
- Decreases blood glucose
- Increases need for food

**Clinical Manifestations of Hypoglycemia and Hyperglycemia**

**Hypoglycemia**
- Headache
- Irritability
- Nervousness
- Difficulty concentrating
- Pallor
- Tachycardia
- Tremors
- Headache
- Normal breath odor

**Hyperglycemia**
- Rapid onset
- Irritable, nervous, difficulty concentrating
- Pallor
- Tachycardia
- Tremors
- Headache
- Normal breath odor
- Gradual onset
- Lethargy
- Deep rapid breathing
- Weak pulse
- Flushed skin
- Dry mucous membranes
- Weakness
- Abdominal pain
- Fruity breath
Mild Hypoglycemia

- **Symptoms**
  - Grouchiness
  - Shakiness
  - Sweating
  - Fast heart rate
  - Pale skin
  - Dizziness
  - Yawning

- **Quick-acting Sugar**
  - 15 Grams of carbohydrate
  - See Guidelines for Treating Lows by Age
  - If not better in 15 minutes, repeat treatment
  - If the next meal or snack is more than 30 minutes away give an extra snack of carbohydrate and protein

Moderate Hypoglycemia

- **Confusion**
- **Poor coordination**
- **Inability to cooperate**
- **Slurred speech**

- **Instant Glucose or Cake Frosting Gel**
  - Insert tube between gum and cheek
  - Administer appropriate amount
  - If no response in 15 minutes administer glucagon
  - If the next meal or snack is more than 30 minutes away give an extra snack of carbohydrate and protein

Severe Hypoglycemia

- **Unconsciousness**
- **Convulsions**

- **Glucagon**
  - Administer Glucagon as directed
  - Call paramedics
  - Phone diabetes doctor on call
  - Feed as soon as possible after awakening
  - Review expiration date and instructions in the Spring and Fall

Treating hypoglycemia

- ✗ If child is showing signs of hypoglycemia, test blood glucose
- ✗ If BG is < 70, give glucose rapidly using
  - Orange juice
  - Small box raisins
  - 3-4 glucose tablets
- ✗ Wait 15 minutes, retest blood glucose. If it is still < 70, wait another 15 minutes and retest
- ✗ When BS > 80 give a more substantial snack, (cheese & crackers) if meal will be > 30 min away
- ✗ If child is unconscious, administer IM or IV glucagon or spread glucose paste on tongue

Glucagon

- Im injection
- Stimulates the release of liver glycogen and releases glucose into the circulation

Diabetes Terminology

- ✗ Honeymoon phase: effort of pancreas to secrete insulin after initial treatment with insulin
- ✗ Somogyi Phenomenon: rebound hyperglycemia after an episode of hypoglycemia
- ✗ Growth Hormone blocks glucose utilization and stimulates hepatic glucose output (antagonizes insulin)
- ✗ Dawn Phenomenon: early morning hyperglycemia secondary to growth hormone/epinephrine secretion
<table>
<thead>
<tr>
<th>Type II diabetes</th>
<th>Severity of disease in adolescents</th>
</tr>
</thead>
<tbody>
<tr>
<td>- 0.5% of adolescents have diabetes</td>
<td></td>
</tr>
<tr>
<td>- 71% have type I</td>
<td></td>
</tr>
<tr>
<td>- 29% have type II</td>
<td></td>
</tr>
<tr>
<td>- 39,000 teens with type II diabetes</td>
<td></td>
</tr>
<tr>
<td>- Burdened with comorbidities</td>
<td></td>
</tr>
<tr>
<td>- More frequent Complications</td>
<td></td>
</tr>
<tr>
<td>- Microalbuminuria</td>
<td></td>
</tr>
<tr>
<td>- Hypertension</td>
<td></td>
</tr>
<tr>
<td>- Retinopathy</td>
<td></td>
</tr>
<tr>
<td>- Peripheral nerve abnormality</td>
<td></td>
</tr>
<tr>
<td>- Obesity</td>
<td></td>
</tr>
<tr>
<td>- Cardiovascular risk</td>
<td></td>
</tr>
</tbody>
</table>

| 14 year old african american with irregular periods  |
| PCOS  |
| Wt. 188  |
| BMI 29.2  |
| BP 128/84  |
| Elevated blood sugar 256  |
| Family history  |
| A1c=8  |

| Metformin as first-line pharmacotherapy  |
| Start with insulin therapy, diet and exercise  |
| Attempt to wean off insulin  |
| Get A1C down less than 7  |

| Facilitating Self-Management Among Teens with Type 2 Diabetes  |
| Diabetes Care in Adolescents  |
| - Family members with diabetes can be role models but can also teach nonadherence  |
| - Encourage parental involvement in youth’s diabetes care  |
| - Positive parenting  |
| - Verbal reminders  |
| - Communicate with school personnel  |
| - Giving the child space when “stressed”  |
| - Importance of problem-solving skills  |
| - Encourage a family-wide change in eating habits  |
| - Use technological advances to allow the child to maintain greater perceived normalcy  |
| - Insulin pumps  |
| - Insulin pen  |
| - Provide ongoing diabetes education  |
| - Type 2 diabetes in youth is increasing, and rates of diabetes complications are higher than in type 1 peers  |
| - Metformin is the only oral agent approved for pediatric use  |
| - Has beneficial effects on insulin resistance and comorbidities, but may not be sufficient to meet glycemic targets  |
| - It is important to consider the influence of pubertal hormones, psychosocial development and family environments  |