Pediatric Endocrine Disorders

Hypothyroidism

- Metabolic disorder
- May be familial or sporadic
- May progress as permanent or transient disorder
- Congenital vs. acquired
  - Congenital- may affect fetus in 1st trimester
  - Juvenile- acquired- usually have onset in childhood or adolescence

Hypothyroidism

- Primary vs. secondary
  - Primary- disease or disorder of thyroid gland
  - Secondary- disease or disorder of hypothalamus or pituitary gland compromises thyroid gland function

Hypothyroidism

- Etiology/ Incidence
  - Congenital Hypothyroidism
    - Absence, underdevelopment or atrophy of thyroid gland most common
    - Inherent dysfunction in transport or assimilation of iodine or in synthesis or metabolism of thyroid hormone
    - Maternal disease adversely affecting fetal thyroid development and function

Hypothyroidism

- Iodine deficiency causing endemic goiter and cretinism
- Hypothalamic or pituitary disorder
- Affects 1 infant in every 4000 live births
- Higher incidence in Hispanic and Native-American infants
- Higher incidence in areas with endemic iodine deficiency

Hypothyroidism

- Juvenile-acquired Hypothyroidism
  - Chronic lymphocytic thyroiditis
  - Late manifestation of congenital absence
  - Ablation of thyroid through medical procedure
  - Exposure to iodine-containing drugs and agents
  - Disease of hypothalamus or pituitary
  - Endemic goiter from nutritional iodine deficiency

Hypothyroidism

- Signs and symptoms
  - Affects multiple systems
  - May be family history
  - May be associated with other autoimmune disease or syndromes
  - Neonates/infants
    - Infants have no obvious signs during first month
    - History of lethargy, poor feeding, elevated bilirubin
    - May be post-mature
  - Older infants, children, adolescents
    - History of poor growth
    - Developmental delay

Hypothyroidism

- Differential diagnosis
  - Differentiate primary Hypothyroidism due to intrinsic thyroid gland defects from secondary thyroid deficiency caused by pituitary or hypothalamic disorders
  - Congenital thyroxine-binding globulin deficiency

Hypothyroidism

- Physical Findings
  - Affects multiple systems
  - Neonates/infants
    - Prolonged jaundice
    - Growth deceleration
    - Hypothermia, skin mottling
    - Large fontanels
    - Normal, slightly enlarged thyroid gland
    - Hoarse cry
    - Axillary, prominent supraclavicular fat pads
    - Respiratory distress in term infant
    - Bradycardia
    - Distended abdomen
    - Lumbar lordosis

Hypothyroidism

- Findings-Infants, children, and adolescents
  - Increased weight for height
  - Linear growth retardation
  - Developmental delay
  - Delayed puberty
  - Skin cool, pale, gray, thickened
  - Hair dry, brittle
  - Possible enlarged thyroid gland
  - Galactorrhea
  - Myopathy
  - Delayed bone age

Hypothyroidism

- Diagnostic Tests/Findings
  - Newborn screening for congenital Hypothyroidism is routine in all 50 states
    - If abnormal- repeat
    - Evaluated serum TSH and low T_4 diagnostic of congenital hypothyroidism. May also test serum thyroxine-binding globulin
    - Positive TSH receptor-blocking antibodies- diagnosis for transient congenital Hypothyroidism
    - May also test- TBG, T_3RU

Hypothyroidism

- Tests/findings con't
  - Acquired Hypothyroidism secondary to pituitary or hypothalamic disorder
    - Low TSH, low T_4 level, low T_3RU
    - Abnormal pituitary function tests
  - Euthyroid sick syndrome secondary to acute or chronic illness-low T_4,normal TBG, low T_3,normal TSH, free T_4 and reverse T_3 normal to high

Hypothyroidism

- Tests/findings con't
  - Autoimmune thyroiditis-(Hashimoto's) with goiter-normal T_4 and TSH; elevated serum thyroid peroxidase or thyroglobulin antibody titers
  - Repeat thyroid function tests if clinical suspicion of hypothyroidism, history of disease in pregnancy, positive history
  - May have abnormal thyroid scan, ultrasound, imaging, or bone age results

Hypothyroidism

- Management/Treatment
  - Physician consultation or referral to endocrinologist
  - Drug of choice daily oral levothyroxine
  - Once older children in euthyroid state- monitor their thyroid levels
  - Educate parents and child about disease
  - Excessive production and secretion of thyroid hormone-TH

Hyperthyroidism

- Etiology/ Incidence
  - Caused by excess production of thyroid hormone-TH
  - Autoimmune response-Graves'- most common cause
  - If mother is thyrotoxic prenatally or has history of Graves', infants may have transient congenital Hyperthyroidism
  - More common in girls than boys

Hyperthyroidism

- Signs and symptoms
  - May have family history
  - Neonates/infants
    - Usually have signs shortly after birth
    - Prematurity, low birth weight, poor weight gain, weight loss
    - Fever, flushing

Hyperthyroidism

- Child/ Adolescent S/S
  - Weight loss, increased appetite
  - Nervousness, irritability, decreased attention span
  - Sleep restlessness
  - Visual disturbance
  - Palpitations and increased heart rate
  - Trembling
  - Frequent urination and stooling
  - Amenorrhea

Hyperthyroidism

- Differential Diagnosis
  - Neonates
    - systemic illness
  - Children and adolescents
    - Nodular thyroid disease
    - Thyroid cancer
    - Euthyroid goiter
    - Chronic disease
    - Thyroiditis
    - Accidental or deliberate excessive thyroid hormone or iodine ingestion
    - Chorea
    - Psychiatric illness

Hyperthyroidism

- Physical Findings
  - Neonates and infants
    - May be small for gestation age
    - Lid retraction
    - Face may be flush
    - Enlarged thyroid
    - Cardiac problems
    - Increased gastrointestinal motility

Hyperthyroidism

- Children and adolescents
  - Warm, moist, smooth skin, diaphoretic skin
  - Eye findings- proptosis, exophthalmos, upper lid lag with downward gaze, lid retraction, stare appearance, periorbital and conjunctival edema
  - enlarged thyroid, tender or nontender, spongy or firm with palpable border; may have thyroid bruit or thrill
  - Increased pulse rate, systolic hypertension, increased pulse pressure
  - Muscle weakness
  - Diminished motor skills, tremor, short DTR relaxation phase
  - Advanced skeletal maturation radiographically

Hyperthyroidism

- Diagnostic Tests/Findings
  - If signs or symptoms of thyrotoxicosis or enlarged thyroid, do confirm lab thyroid function tests
  - Thyroiditis indicated by elevated T_4, free T_4, T_3 resin uptake and low serum cholesterol
  - Circulating thyroid simulator immunoglobulin and other thyroid antibody tests including thyrotropin receptor antibody titers may be positive
  - May have moderate leukopenia, hyperglycemia, and glycosuria
  - Graves' Disease- low TSH, elevated T_4, advanced bone age
  - radioactive iodine uptake scan shows increased uptake if excess TH production. If increased released of TH only, will have decreased radioactive iodine uptake
  - High T_4 not always hyperthyroidism, must also have low TSH, with high T_4

Hyperthyroidism

- Management/Treatment
  - Physical consultation- pediatric endo
  - Treatment dictated by identified etiology
  - Prompt diagnosis and treatment, especially important in neonates as condition may be life-threatening.
  - Treatment goal is prompt return euthyroidism
  - Restricted physical activities-with severe disease or in prep for surgery
  - Educated parent and child about disease
  - Genetic counseling may be indicated

Thyroiditis

- Etiology/Incidence
  - Acute suppurative thyroiditis with bacterial etiology-e.g.... GABHS, pneumococci, S. aureus, and anaerobes; rare
  - Subacute, nonsuppurative caused by viruses e.g.-mumps, influenza, echovirus, coxsackie, Epstein-Barr, adenovirus; rare in US
  - Chronic autoimmune lymphocytic- most common cause of goiter and hypothyroidism in childhood

Thyroiditis

- Signs and Symptoms
  - May have recent family history of concurrent upper respiratory illness
  - May have recent family history of autoimmune thyroid disease
  - Onset is acute- rapid
  - Fever, malaise-may be very ill
  - Pain and tenderness of thyroid- may radiate to ear, chest. Severe pain with neck extension; no tenderness with chronic lymphocytic thyroiditis
  - Complaints of unilateral or bilateral swelling of thyroid, complaints of fullness in anterior neck; sensation of tracheal compression
  - May have sore throat, hoarseness, dysphasia
  - May have nervousness, irritability

Thyroiditis

- Differential Diagnosis
  - Distinguish between infectious toxic thyroid thyroiditis and chronic lymphocytic autoimmune thyroiditis
  - Goiters induced by drugs
  - Cancerous or cystic thyroid nodules

Thyroiditis

- Physical Findings
  - Findings variable depending on etiology
  - May be toxic-appearing if infectious etiology but not necessarily thyrotoxic
  - If infectious- thyroid gland unilaterally or bilaterally enlarged, tender, firm

Thyroiditis

- Diagnostic Tests/ Findings
  - Laboratory findings variable depending on etiology
  - In infectious- serum total T_4, free T_4, and T_3RU usually normal or slightly elevated
  - In chronic- elevated TSH and thyroid antibodies, abnormal thyroid scan
  - Surgical or needle biopsy diagnostic

Thyroiditis

- Management/Treatment
  - Physical consultation
  - Specific antibiotic therapy
  - Treatment for autoimmune chronic lymphocytic thyroid controversial
  - Adolescents need lifelong monitoring
  - Genetic counseling may be indicated

Short Stature

- **Definition**
  - Variation from average pattern of growth height > 2 standard deviations below mean
- Etiology/Incidence
  - Normal growth variations
    - Familial or genetic normal variant of average growth pattern
    - Constitutional delay of growth
    - Puberty
  - Primary growth abnormalities
    - Osteochondrodysplasia
    - Chromosome abnormalities
    - Intrauterine growth retardation
    - Dysmorphic syndromes

Short Stature

- Secondary growth failure
  - Malnutrition
  - Chronic illness
    - Gastrointestinal disease
      - Celiac disease
      - IBD
      - Cystic fibrosis
    - Cardiovascular disease
      - Cyanotic heart disease
      - Congestive heart failure
    - Renal disease
      - Uremia
      - Renal tubular acidosis
    - Hematologic disorders
    - Inborn errors of metabolism
    - Pulmonary disease
    - Chronic infection
    - Anorexia nervosa

Short Stature

- Endocrine disorders
  - Hypothyroidism
  - Cushing syndrome
  - Pseudohypoparathyroidism
  - Rickets
  - IGF-1 deficiency
    - GHD
    - Growth hormone insensitivity
    - Defects in IGF synthesis

Short Stature

- Signs and Symptoms
  - Normal growth variation
    - Familial short stature- small at birth
    - Constitutional growth delay- usually normal size at birth
  - Pathologic growth variation
    - nutritional
      - History of poor nutritional intake
      - malabsorption
    - Endocrine-growth hormone deficiency 1 in 4000
      - Failure to grow, headaches, delayed dental development , developmental delay, dull appearance, polyuria, polydipsia
    - Intrauterine growth retardation and low birth weight
    - Dysmorphism at birth
    - Signs and symptoms of neglect
    - Chronic drug intake

Short Stature

- Differential Diagnosis: Distinguish normal variants of familial short stature and constitutional growth delay from pathologic causes
- See pathological growth variations

Short Stature

- History
  - Pregnancy , delivery, newborn period
  - Parents' and siblings' height, weight and growth pattern
  - When growth started to slow
  - Chronic illness
  - Symptoms of hypothyroidism or other pituitary hormone deficiency
  - Trauma or insult to the CNS
  - Signs of an intracranial lesion

Short Stature- Exam

- Examine for clues to
  - Chronic illness
  - Dysmorphic syndrome
    - Childlike face with large prominent forehead
- Evaluation of the fundi for signs of ICP
- Palpation of the thyroid gland for a goiter
- Evaluation of the stage of puberty
- Measurements of body proportions
  - Arm span compared with height
  - Upper to lower segment ratio
    - Measure from the symphysis pubis to the heel to get the lower segment
      - Tables exist for children of all ages

Short Stature

- Physical Findings
  - Familial or constitutional- Height, weight, HC growth curve patterns consistent
    - Familial- growth chart showing BW < 3%
    - Constitutional- normal size at birth then declining through 1 to 3 years to <5%
  - Pathologic short stature
    - GH deficiency –BW may be normal, length 50% of normal, height and weight deficits; infantile fat distribution; youthful facial features; midface hypoplasia; visual field defects; small hands and feet; newborn may have microphallus(stretched penile length of <2.5cm vs. 4cm-normal) ;may have CNS findings

Short Stature

- Physical findings-pathologic-con't
  - Primordial short stature
    - IUGR-subsequent growth <3rd percentile
    - Primordial dwarfism with premature aging
    - Short stature with and without dysmorphism
  - Short stature associated with chromosomal abnormalities-Turners, Downs
  - Short stature associated with bone or cartilage development disorder: skeletal dysplasia, short extremities with normal head and trunk, frontal bossing, disproportionate, rickets

Short Stature

- Short stature associated with symptoms of endogenous cortisol excess: moon facies, hirsutism, buffalo hump, striae, hypertension, fatigue, deep voice, obesity, amenorrhea
- Chronic drug intake
- Abnormalities in psychosocial development

Short Stature

- Exam Findings
  - Abnormalities in previous recordings of height, weight, and HC
  - Height may be < 3rd percentile but growth rate normal
  - May have abnormal complete and segmental growth measurements and upper to lower body ration measurements

Short Stature

- Lab test to confirm diagnosis
  - Abnormal CBC-chronic anemia, infection, leukemia
  - Elevated sedimentation rate-vascular disease, cancer, chronic infection
  - Abnormal biochemical profiles-adrenal insufficiency, renal disease
  - Abnormal stool examination-inflammatory bowel, parasitism
  - Abnormal thyroid function studies-hypothyroidism
  - Low serum human growth hormone
  - Abnormal urinalysis-renal disease

Short Stature

- Lab tests to confirm-con't
  - Delayed maturity on radiographic bone age
  - Nutritional evaluation may show inadequate calories
  - Abnormal home/social evaluation may suggest psychosocial etiology
  - Abnormalities on skull-x-ray, CT,MR-inter cranial lesions
  - Karyotype analysis in short girls with pubertal delay may indicate Turner syndrome

Short Stature

- Management/Treatment
  - Physician consultation - Endo
  - Boys may need short-term testosterone to initiate sexual development
  - Optimize treatment for other endocrine of systemic or chronic illnesses, adequate calories
  - GH may be indicated for children with know GH deficiency-controversial
    - The FDA has approved a number of indications for GH TX
    - The cost can be as high as 19,000 a year- if not covered by ins
    - Sides effects include
      - Insulin resistance, pseudotumor, edema, growth of nevi, carpal tunnel

Excessive Growth

- Variation from average pattern of growth in linear height with height >2 SD above the mean
- Etiology/Incidence
  - Normal variation in growth- tall structure
  - Pathologic variation in growth
    - Endocrine disorder
      - IDM or GH excess or precocious puberty
      - Genetic causes
        - Marfan syndrome-connective tissue disorder
        - Chromosomal abnormalities- Klinefelter syndrome, XYY, XXYY

Excessive Growth

- Other Etiology
  - Idiopathic or exogenous obesity-early puberty with accelerated growth-not beyond genetic potential
  - Homocystinuria-inherited inborn metabolism error
  - Cerebral gigantism-possible hypothalamic dysfunction, adult stature normal to excessive

Excessive Growth

- Signs and Symptoms
  - Concerns primarily with girls/parents
  - Symptoms variable depending on underlying etiology
  - Familial or constitutional tall stature-Length normal at birth, tall stature evident at 3 to 4 years-growth rate slows after 4-5 years with normal curve
  - IDM-Hx maternal diabetes, LGA
  - Beckwith-Wiedemann-LGA, rapid growth in childhood; concern about height; symptoms of hypoglycemia

Excessive Growth

- Signs and symptoms con't
  - GH excess- headache, visual impairment, coarsening of facial features, enlargement of nose and jaw, increases in hands and feet, polyuria, polydipsia, irregular menses, joint pain
  - Precocious puberty- concern about height, early development

Excessive Growth

- Signs and Symptoms con't
  - Klinefelter's syndrome
  - Marfan's-height, vision, cardiac problems
  - Obesity-normal height and weight at birth
  - Homocystinuria-concern about height, MR, vision, CNS sx, back pain
  - Cerebral gigantism-rapid growth, feeding problems and developmental delay

Excessive Growth

- Differential Diagnosis- normal variants need to be distinguished from pathologic causes
- Physical Findings
  - Constitutional tall stature- 2 to 4 SD above average height for age

Excessive Growth

- Physical findings con't
  - Endocrine disorder
    - IDM- LGA at birth
    - GH excess- tall
    - Precocious puberty- tall
  - Genetic disorders
    - Marfan's- tall stature, dolichocephaly, abnormal proportions, scoliosis, myopia, heart murmur, hypotonicity, pectus excavatum, joint issues
    - Klinefelter syndrome- tall stature, underweight, MR, long legs, abnormal proportions, normal penis with small testes with decreased sensitivity to pressure, cryptorchidism, hypospadias

Excessive Growth

- Physical findings con't
  - Other causes of tall stature
    - Obesity-normal exam
    - Homocystinuria-tall, myopia, CNS sx, convulsion, MR, osteoporosis, vertebral collapse
    - Cerebral gigantism-dysmorphic, abnormal proportions, MR, macrocephaly ,dolichocephaly, prominent forehead, hypertelorism with other ocular issues, high palate, pointed chin ,CNS sx, poor motor coordination
    - Beckwith-Wiedemann Syndrome-omphalocele, umbilical hernia, accelerated growth in childhood, macroglossia, high palate, midface hypoplasia, hemihypertrophy
    - Diagnostic Tests/Findings
      - Recordings of height/weight and OFC on growth chart show height >2 SD above mean for age

Excessive Growth

- History/Diagnostic Tests/Findings
  - Recordings of height/weight and OFC on growth chart show height >2 SD above mean for age
  - Careful family history of tall growth patterns may elucidate familial etiology of tall stature
  - Lab tests to confirm diagnosis bases on clinical findings and rule out endocrine disease
  - Radiographic bone age not advance in constitutional tall stature

Excessive Growth

- Diagnostic tests/findings con't
  - Abnormal echocardiogram with Marfan's
  - Abnormalities on skull radiograph, CT, or MRI of cranium
  - Karyotype analysis may indicate chromosomal abnormalities

Excessive Growth

- Management/Treatment
  - Physical consultation
  - Pharmacological management controversial
  - Homocystinuria- restrict dietary methionine
  - GH excess from CNS tumor or adrenal or gonadal tumor
  - Management of endocrine disease associated with tall stature
  - Beckwith-Wiedemann- treat excess insulin production

Hypoglycemia

- Symptoms provokes by abnormally low blood glucose levers occurring when child with diabetes receives excessive insulin, fails to eat, or exercises too strenuously; in child without diabetes, blood glucose lever must be <40 mg/dL and <30 mg/dL in newborns

Hypoglycemia

- Etiology/Incidence
  - Transient neonatal Hypoglycemia
    - SGA infants with decreased production of blood sugar
    - LGA IDM-exposure to maternal blood sugar
    - Increased glucose use-physiologic stressors secondary to asphyxia, respiratory illness, heart disease, cold injury, starvation
  - Hypoglycemia of childhood
    - Hyperinsulinism
    - Functional fasting Hypoglycemia
    - Associated with CNS disorders
    - Metabolic disorders and endocrine insufficiency
    - Severe malnutrition states
    - Other-drug ingestion, drug toxicity(alcohol, aspirin, oral hypoglycemic agents)

Hypoglycemia

- Signs and Symptoms
  - Neonatal- findings variable-
    - Irritable
    - Jittery
    - Refusal to feed
    - Tend to be small for age
  - Childhood
    - Mood changes, nervousness, weakness, hunger, vomiting
    - History-family; may have symptoms of metabolic or hormonal disorders
    - Functional fasting-ketotic hypoglycemia-vomiting, anorexia, URI, may have early morning seizures

Hypoglycemia

- Differential Diagnosis
  - Distinguish among various possible etiologies of Hypoglycemia
    - Functional (fasting)
    - Ketotic
    - Inherited disease

Hypoglycemia

- Physical findings
  - Neonatal
    - Cachexia or macrosomic infant
    - Irritability, lethargy, weak cry
    - Hypothermia, cyanosis, diaphoresis, pallor
    - Uncoordinated eye movement, eye-rolling
    - Apnea, irregular breathing, tachycardia
    - Twitching, jitteriness, convulsions, semi consciousness, coma

Hypoglycemia

- Physical findings con't
  - Childhood
    - Signs same as neonate
    - Diminished growth
    - Difficulty talking
    - Signs of other systemic illness
    - Abdominal or pelvic masses
    - Unsteady gait
    - Concurrent illness

Hypoglycemia

- Diagnostic tests/finding
  - Transient neonatal hypoglycemia-routine Dextrostix; if
    - Whole blood glucose level <35 in first 24 hours or <40 there after or…
    - Plasma glucose level < 40 in first 23 hours or <45 thereafter
  - Low blood glucose during episode; consistent and repeated levels below 40 with associated signs-need further workup
  - In hyperinsulinemia, serum insulin levels may be inappropriately elevated when compared with glucose level obtained at same time

Hypoglycemia

- Management/treatment
  - Consultation with endo
  - Treat hypoglycemic episodes promptly and adequately
  - Hypoglycemic reactions in children with diabetes-
  - Surgery for pancreatic adenoma, partial pancreatomy if insulin secretion suppression unsuccessful
  - Children with function (fasting) hypoglycemia-treat with liberal carbohydrate diet with bedtime snacks, moderate restriction on ketogenic foods; avoid prolonged fasting; parents may need to check urinary ketones

Hyperglycemia-FYI

- Common hereditary metabolic and endocrine disorder characterized by insulin deficiency resulting in abnormal metabolism of carbs, protein, and fat
- Always admitted to pediatric hospital with onset- to endo services- never treated in primary care!!

Pubertal Development

- Normal Puberty
  - Physical changes occur in response to production of sex steroids by the ovaries or testes
  - Hypothalamic gonadotropin-releasing hormone regulates the release of luteinizing hormone and follicle stimulating hormone from the pituitary gland which in turn stimulate gonadal hormone secretion
  - Normal age range for entering puberty in girls is now earlier
    - Signs may be noted as early as 6 years old in African American girls and 7 years old in Caucasian girls
  - The timing of menarche and reaching tanner stage 5 has not changed dramatically
    - Menarche happens with 3 years of start of breast development
    - 95% of girls will have started puberty by 13 years old
  - Boys may begin puberty as young as 9 years and the upper range is age 14 years
    - The first sign of puberty is increased testicular volume in 85% of boys

Disorders of Pubertal Development

- Early Puberty
  - Four categories
    - Premature thelarche
      - Occurs in infant and toddler girls-is isolated breast development
      - Rarely progresses to true precocious puberty
    - Premature adrenarche
      - Early onset of pubic hair in boys or girls, not associated with other features of true puberty, is most often idiopathic
      - These children are at increased risk for PCOS and metabolic syndrome
    - Isolated menarche
      - Is uncommon, is one to a few episodes of vaginal bleeding without breast development
      - Rule out sexual abuse, vaginal tumor, functional ovarian cyst that produces estrogen and primary hypothyroidism
    - True precocious puberty

Disorders of Pubertal Development

- Precocious puberty
  - The onset of multiple features of puberty earlier than normal range
    - May include
      - Accelerated linear growth
      - Breast development or penis enlargement
      - Pubic hair development
      - Bone age may be advanced
  - Divided into two broad categories
    - Central, gonadotropin dependent
      - Idiopathic
      - CNS disorder
    - Peripheral, gonadotropin independent
      - Girls- McCune Albright syndrome, ovarian cyst, estrogen secreting ovarian or adrenal tumor
      - Boys- severe, non-salt wasting, congenital adrenal hyperplasia
      - Testotoxicosis, testicular tumor
  - FYI- prolonged exposure to exogenous sex hormones can also cause precocious puberty
    - Mothers birth control pills or fathers topical testosterone

Disorders of Pubertal Development

- History
  - Symptoms; such as
    - Breast development, pubic hair, phallic enlargement, acne, body odor, oily scalp
  - Age of onset
  - Progression
  - Duration
  - Pattern of growth
  - Any symptoms of CNS lesion
  - Pattern of family puberty
  - Exposure to topical estrogens or testosterone or oral estrogens

Disorders of Pubertal Development

- Physical Exam
  - Assessment of stature and growth velocity
  - Description of the tanner stage
- Diagnostic tests
  - Premature thelarche
    - No tests
  - Premature adrenarche
    - Serum 17 hydroxpyrogesterone
      - To exclude congenital adrenal hyperplasia
    - 24 hour urine for 17-ketosteroids or Imaging of the adrenal glands
      - To exclude an adrenal tumor
  - Isolated menarche
    - Thyroid function
      - To exclude primary hypothyroidism
    - Pelvic ultra sound
      - To look for ovarian cyst or pelvic tumor

Disorders of Pubertal Development

- Precocious puberty
  - Bone age
  - LH, FSH, estradiol or testosterone
    - If the LH and FSH are high do an MRI to exclude CNS tumor
    - If LH and FSH are low do a GnRH stimulation test to distinguish central from peripheral puberty
      - For peripheral
        - Pelvic or testicular ultrasonography
        - Serum 17-OHP to sure out sever CAH

Disorders of Pubertal Development

- Management of precocious puberty done with the guidance of Endo
  - Treatments depend on;
    - the underlying disorder
    - Age of the child
    - Advancement of the bone age
    - Childs and family's emotional response to the condition
  - Treatments include
    - radiation, surgery, or chemotherapy for CNS tumor
    - Long acting GnRH agonist to bring serum sex steroids to prepubertal levels
  - Treatment goal is to increase final adult height

Disorders of Pubertal Development

- Delayed Puberty
  - Puberty is considered delayed when a boy 14 years or older or a girl 13 years or older has no clinical features of puberty
  - Epidemiology
    - Any chronic condition that delays the bone age may cause delayed puberty (since the bone age correlates with puberty better than the chronologic age)
    - Also failure of any part of the hypothalamic-pituitary –gonadal axis may also delay puberty
    - The most common cause of delayed puberty is Constitutional Growth Delay
      - Which is covered in the failure to thrive lecture
    - Other causes include
      - Chronic illness
      - Growth hormone deficiency

Disorders of Pubertal Development

- Clinical findings in delayed puberty
  - History and physical should focus on:
    - Clinical clues indicating a chronic illness
      - Signs and symptoms of hypothyroidism
      - History of CNS insult
      - New CNS symptoms suggesting hypopituitarism
    - ROS
      - Pattern of growth
      - Sense of smell
      - Galactorrhea

Disorders of Pubertal Development

- Diagnostic tests
  - Screen for acute and chronic illness
    - CBC
    - Sed Rate (ESR)
    - UA
    - Liver enzymes
    - Electrolytes (renal function)
  - Bone age
  - Thyroid screening
  - IGF-1 and IGFBP-3 if growth hormone deficiency suspected
  - Serum prolactin
  - LH and FSH
    - When gonadal failure is present, LH and FSH are abnormally elevated if the bone age is older than 11 years in a girl and 12 years in a boy

Disorders of Pubertal Development

- Management of delayed puberty
  - Refer to Endo
    - hormone replacement is the treatment of choice for hypogonadism

Gynecomastia

- Definition
  - Visible glandular enlargement of the male breast
- Etiology/Incidence
  - Neonatal-due to cross-placental transfer of maternal hormones; usually resolves by 2 to 3 weeks
  - Pubertal- too little androgen and/or too much estrogen on mammary tissue, may occur in up to 75% of normal boys
  - Pathologic- secondary to drug side effects, underlying disease

Gynecomastia

- Signs and Symptoms
  - Breast development in other then pubertal females
- Differential diagnosis
  - Obesity
  - Breast infection
  - Fat necrosis due to injury
  - Drugs
  - Klinefelter's

Gynecomastia

- Physical Findings
  - Neonatal-usually bilateral, tissue enlargement
  - Pubertal-breast tissue enlargement, movable, disk-shaped
  - Pathologic- malnourishment, lymphadenopathy, delayed sexual maturity

Gynecomastia

- Diagnostic Tests
  - Endocrinology studies as indicated
  - Imaging techniques as appropriate
  - Karyotyping if Klinefelter's suspected

Gynecomastia

- Management
  - Neonatal- Parent education
  - Pubertal- explanation, reassurance and observation
  - Physiologic- medical or surgical treatment is usually required

Amenorrhea

- Definition-
  - Primary amenorrhea-failure of onset of menarche in females who are 16 years and have normal pubertal growth and development; 14 years with absence of normal growth and development; or in girls who not begun menstruation 2 years after completed sexual maturation
  - Secondary amenorrhea-absence of menstruation for > 3 cycles at least 6 months after menstruation established

Amenorrhea

- Etiology/Incidence
  - Primary
    - Constitutional/familial – common
    - Obstruction of flow e.g. fusion or stenosis, imperforate hymen
    - Estrogen deficiency
      - Primary ovarian insufficiency-organic or functional ovarian failure e.g. anatomic anomalies, pelvic irradiation, enzyme defects, autoimmune disease, infection
      - Secondary-hypothalamic/pituitary disorders e.g.-DM, CF, anorexia, excessive exercise, endocrine disease
    - Androgen excess e.g.-polycystic ovaries, adrenal androgen excess (Cushing's)
    - Ovarian tumors

Amenorrhea

- Etiology-Secondary amenorrhea; many causes same as primary
  - Pregnancy-most common
  - Hypothalamic, pituitary and adrenal disorders
  - Tumors
  - Chromosomal abnormalities (Turners);
  - Endocrinopathies
  - Chronic illness-esp… with weight loss
  - Conditions affecting gonadal function
  - Pharmacological agents (discontinuance of birth control pills, use of tranquilizers)
  - Significant emotional stress or strenuous exercise programs-especially with runners, ballet dancers, and gymnasts, major weight loss
  - Uterine dysfunction after abortion, infection or C-Section
  - Hysterectomy

Amenorrhea

- Signs and Symptoms
  - Primary-no history of menses in adolescence; may have symptoms of stress, adrenal dysfunction or gonadal disease, pituitary or hypothalamic disease, chronic illness including eating disorders, chromosomal abnormalities, pregnancy, cyclic abdominal pain without menstruation in pseudoamenorrhea
  - Secondary-sudden or gradual cessation of menses; symptoms vary depending on etiology; may exercise excessively

Amenorrhea

- Differentials-
  - Determine if underlying etiology due to chronic illness, CNS disease, endocrinopathy
  - Distinguish primary amenorrhea due to constitutional or familial etiology, from pregnancy
  - Distinguish secondary amenorrhea due to pregnancy, underlying disease or disorder
  - Determine amenorrhea vs. pseudoamenorrhea (menstruation occurs but obstruction prevents release of menstrual blood)

Amenorrhea

- Physical Findings
  - May have normal exam, or signs of chronic disease, syndromes, may show signs of pregnancy
  - May lack development of secondary characteristics or normal sexual development
  - Pelvic exam may show pregnancy, reproductive system abnormalities e.g. cervical atresia, imperforate hymen

Amenorrhea

- Diagnostic Tests/Findings
  - Pregnancy test
  - Careful family history to rule out constitutional/family delay,
  - Consultation with physician and/or referral to specialists as needed.

Amenorrhea

- Management and Treatment
  - Constitutional/family primary amenorrhea – educate, reassurance, monitoring
  - Amenorrhea associated with other etiologies requires further evaluation, physician consultation or referral to specialist
  - Treatment directed at management or correction of underlying cause of abnormal menstrual process
  - Sensitivity to significant concern of delayed development by child and family—very important
  - Parent and child education to cause and treatment
  - Genetic counseling-PRN