

Endocrine Glands Review

- Development – 1st trimester
- Pituitary
- Thyroid & Parathyroid
- Thymus
- Adrenal
- Pancreas
- Ovaries/Testes

Endocrine system glands Review

- Vital function - produce & secrete hormones. If you know the vital function of the organ, then you know what happens when it stops working and stops secreting hormones.
- Regulate body functions
 - Metabolic
 - Growth
 - Fluid & elect balance
 - Stress response
 - Sexual maturation
 - Glucose metabolism

Physiology Review

- Endocrine/ Nervous System have very close relationship.
- Most of the hormones come from the pituitary (anterior and posterior pituitary)
- What could cause a dysfunction here? An infection of the brain such as encaphalitis or meningitis, tuberculosis (can affect the brain), and syphillis...a tumor in the brain, head injury, anorexia (messes up the hormone pathway...fat is a precursor to hormone production, and she doesn't have any)infarction of pituitary d/t diabetes, shock.
- CNS sends message to hypothalamus...says "we have too much" or "too little" ...hypo talk to pituitary to tell it we need more or less of something.

Pathophysiology...problems are caused by one of these:

- Under secretion (most probs in children are due to under secretion)
- Over secretion (more rare)
- End organ unresponsive

Disorder of the Anterior Pituitary: Growth Hormone Deficiency (Hypopituitarism)

- Growth hormone is manufactured and secreted by the anterior pituitary in response to the hypothalamus. It's going to send down GHRF or GHIH (growth hormone releasing factor or growth hormone inhibiting hormone).
- Pathophysiology (hypopituitarism): can be caused by lots of things (see above), but in about 50% of kids the cause is unknown. GH deficiency inhibits somatic growth in all cells of the body.
- Incidence: equal in both sexes, but males are more often evaluated b/c our society values tall men.
- Etiology is idiopathic in about 50%, which is pretty common with these disorders.

Clinical manifestations of GHD

- Short stature (less than 5% on growth chart)
- Deteriorating or absent rate of growth after the first year; will have enough during first year to grow and progress...the deficiency comes into play after first year
- Higher weight-for-height ratio: weight is higher than height..so usually short and a little stocky
- Delayed bone age: look at epiphyseal plate of wrist and hands...these are early ossification centers. (look it up) We are looking to see how much it has calcified...would not be calcified as much as expected.
- Permanent teeth delay: primary teeth come in at regular time, but permanent teeth are delayed
- Underdeveloped jaw...teeth will be crowded b/c not enough space in jaw.
- Sexual development delayed but normal.

- Normal intelligence, but have emotional and academic problems. Why academic problems? Because people treat them as though they are younger than they are.
- HA if child has tumors
- Hypoglycemia b/c growth hormone stimulates glucagon (look this up)

Diagnosis of GHD

- X-ray to check bone age
- MRI to check for tumors and trauma
- Assessment: growth charts
- Blood test: growth hormone levels; indirect levels would be to measure insulin-like growth factors and one other she's not going to ask us about.
- R/O that there's not a problem with thyroid functioning b/c thyroid dysfunction would look similar.
- R/O renal problems b/c kids with renal trouble do not have enough growth hormone?

Treatment of GHD

- Goal is to promote normal growth (stimulate linear growth)
- Early intervention = better outcomes
- Growth hormone: parenterally (IM or SQ)
 - The SQ is a daily injection
 - The IM is a sustained formula that lasts 2-4 weeks
 - Give at bedtime
- Surgery/radiation of tumors
 - This will affect all the other hormones that are produced/secreted there
- Replace hormones after surgery/radiation

Nursing Management

- Assessment
 - 80% is successful...but what is considered a success? 2 cm a year from baseline is considered a success. Most kids go from 3.5-4cm a year to 8.7/year (+/- 1.5)
 - Young children, obese children and severely GHD will respond best
- Ethical Issues: people abuse GH (athletes and such); they now use biosynthetic GH and the only people who have access to it are endocrinologists and other medical specialists...not sure how the athletes are getting it.
 - example of father wanting child to be taller so he can get on Notre Dame team...the problem is that all meds have side effects, and this will definitely have AEs if the child doesn't actually need it.
- Nursing diagnoses
 - Delayed growth and development related to inadequate growth hormone secretion
 - Disturbed body image related to short stature
 - Deficient knowledge related to treatment
- Evaluation
 - Need to see endocrinologist every few months
- Family teaching
 - Preparation, storage, dose, how it's mixed, etc...
 - Give drug at bedtime
 - SE: Na retention (fluid retention), slipped epiphysis (usually in hip area, child will have hip pain), pseudo tumors (will produce a headache), hyperlipidemia, impaired glucose, leukemia
 - Will need to take GH until epiphyseal plate closes or perhaps longer if the pituitary has been removed completely.
 - Financial implication/patient assistance programs: \$50,000 per year. Insurance companies do not always pay for this. Pharmaceutical companies have patient assistance programs (get drugs for free, but you don't qualify if you have drug coverage).

Growth hormone is highest about 45-90 minutes after you get to sleep.

Kids come in and they do a baseline blood draw, then they'll give them things like insulin and glucagon...this is a pharmacological stimulation of GH.

Then they check q 15 minutes for two hours to watch the blood levels for GH.

A certain percentage (about 20%) of the population will test negative even though they are not negative...so in order to be definitive, they have to get the levels TWICE.

Hyperpituitarism

- Etiology: usually connected with infection or a tumor...a lot of time it's a tumor that excretes growth hormone.
- Pathophysiology: GH hypersecretion
- Prior to epiphyseal closure
 - Proportional overgrowth of long bones...can reach 8 feet or more.
 - Weight proportional to height
 - HA related to tumors
 - Possible hyperglycemia & DM: Growth hormone kicks in the glucagon leading to hyperG
- Hyperpituitarism after epiphyseal closure (acromegaly)
 - Long bones don't grow b/c plate is closed
 - Overgrowth of head, lips, nose, tongue, jaw, hands
 - Stimulates increased adrenal androgens
 - Skin hyperplasia
 - Poss hyperglycemia
- Dx: check levels of growth hormone
- Tx: Look at what's causing it and try to treat for that particular cause. If a lesion is present, then surgery is done to remove the tumor. Radiation can destroy pituitary tissue...but will need to replace all the other hormones too!

Precocious Puberty

- Early sexual development d/t increased gonadotropin (excessive for age) caused by premature activation of the hypothalamic-pituitary-gonadal axis (hypothalamus and pituitary talking to the gonads)
- Females 8 and under; breast development at 7 or younger in Caucasian or 6 or younger in AfAm
- Males 9 and under
- Pathophysiology: Lots of causes; can be a disorder of the gonad, adrenal gland or hypothalamic-pituitary-gonad axis; no causative factor in 80-90% of girls; in boys more likely to be due to CNS insult or structural injury.
- Incidence is 5x greater in females than males (in females 80% is idiopathic...new research says possible exposure to exogenous hormones). In males it's usually d/t a tumor. Anti-seizure meds can cause hyperplasia of the gums as well as precocious puberty (the puberty will reverse itself when taken off the seizure meds)
- Clinical manifestations
 - Accelerated growth rate
 - Advanced bone age
 - Premature evidence of secondary sexual characteristics
 - Acne
 - Adult body odor
 - Possible behavior changes
- Diagnosis
 - Complete history
 - Physical Assessment
 - Sexual maturation staging (Tanner staging)
 - Height, weight, span (fingertip to fingertip), upper/lower body ratio
 - Radiological exams, ultrasound, MRI
 - Lab screening (look at FSH, LH, GRH, testosterone...see feedback loop, you are checking all these hormones)
 - Ask about exogenous hormones...GnRH. (meat and milk consumption)
 - Confirm Dx: Eval response to GnRH. We give this to the kids and then we see what their levels are at. If they go to adult levels then this is affirmative for the disorder. (check this)
- Treatment
 - Diet change
 - Surgery/radiation/chemo
 - GnRH analog (binds or blocks the GHRH and stops this process. Pt will be on this until puberty)
 - Comes as a SQ daily injection...or can be an IM q 3-4 weeks as a sustained release form.
 - Initially it might actually increase the hormone...but then drops.
- Nursing management
 - Teaching: Meds, Financial (\$700 - \$1000 per sustained release injection)
 - Support

Disorder of the Thyroid Gland: Congenital Hypothyroidism

- Incidence: females more than males
- Etiology: can be chronic/permanent or transient
 - Permanent: thyroid gland can be absent or in the wrong place
 - Transient: comes from mom being hyperthyroid and taking the medication to decrease thyroid levels; also if mom has asthma and is on expectorants...this can cause baby to be hypoTh as well.
- Pathophysiology: disorder at birth...can cause mental retardation (cretinism)
- Feedback Control in Hormone Production: TSH tells thyroid that it needs to start producing TH. This causes the TSH to go up and the thyroid hypertrophies leading to goiter.
- Clinical manifestations
 - Systems affected: Basal metabolic rate, growth, tissue, temp, motility, CV functioning, neuro reflexes, muscle tone.
 - Goiter
 - Large anterior and posterior fontanel
 - Constipation d/t lack of GI motility
 - Umbilical hernia
 - Prolonged jaundice b/c not excreting the byproducts. The greenish blackish poop is bilirubin...this is a good thing! in this baby, the bilirubin sits in the gut and gets reabsorbed. Bilirubin can cross BBB leading to neuro problems.
 - Hypotonia
 - Hypothermia
 - Swollen eyelids
 - Delayed mental response
- Diagnosis: Labs, Thyroid Scan
 - TSH is high, T4 is low
 - Thyroid scan looks for the gland, the size of the gland, location of the gland
- Treatment: Early Tx prevents Cretinism (severe mental retardation)
 - Give child thyroid hormone
 - Requires frequent evaluation until the levels are balanced.
- Nursing management
 - Growth measures, labs
 - Family teaching: med comes only as a pill. How do you give it to the newborn? Crush it up! Have to give an hour before or hour after feeding. Put it in nonessential fluids or breastmilk in the smallest amount possible. If parents are going to use soy-based formula they need to increase dose b/c the soy competes for the receptor sites. Child will be on this medication FOREVER! (unless transient)

Acquired Hypothyroidism (AKA juvenile, Hashimoto's)

- Incidence and etiology: greater in females than males; usually occurs age 6-adolescence; peak time is puberty. Can be treated or self-limiting.
- Pathophysiology (autoimmune thyroiditis)
 - Circulating auto-antibodies. The immune globulins bind at TSH receptor sites on the thyroid gland...and then they get infiltration and inflammation that leads to fibrosis and scarring of thyroid tissue.
- Clinical manifestations
 - Decreased rate of growth
 - Goiter (enlarged thyroid gland)
 - Weight gain with decreased appetite
 - Constipation
 - Dry skin, thinning or coarse hair
 - Lethargy/ fatigue/ sleepiness/ mental decline
 - Cold intolerance
 - Edema (boggy) of face, eyes, hands
 - Delayed deep tendon reflexes
 - Delayed puberty

- Diagnosis
 - TSH, T4, antibodies
- Treatment
 - Iodine will often work if it's a 3rd world country
 - Thyroid hormone
- Nursing management
 - Assessment
 - Nursing diagnosis: Delayed growth and development related to the absence or deficiency of thyroid hormone synthesis
 - Hypothermia related to decreased BMR
 - Constipation related to decreased motility of the GI tract
 - Activity intolerance related to fatigue and decreased endurance

Disorder of the Thyroid Gland: Hyperthyroidism

- Incidence and etiology
 - Incidence peak is 12-14 years of age (puberty)
 - 5x greater in females than males
 - Largest percentage is Graves Disease (which is autoimmune)
- Pathophysiology
 - Too much thyroid hormone
 - Antibodies mimic action of TSH, causing an increase in TH.
 - Actual TSH will be low (?)
- Clinical manifestations
 - Increased rate of growth
 - Goiter (enlarged thyroid gland)
 - Weight loss despite excellent appetite
 - Warm, moist skin
 - Tachycardia
 - Ophthalmic changes (bulging eyes)
 - Heat intolerance
 - Emotionally labile
 - Insomnia, fine tremors
- Diagnosis: serum thyroid tests
- Clinical concerns
 - Thyroid storm...a huge surge of thyroid hormone that causes temp to go up, major tachycardia, HTN. Have to give them beta-adrenergic blocking agents like **Lidocaine** or **Propranolol** to get things slowed down.
- Treatment
 - Antithyroid medication: **propylthiouracil (propacil)** or **methimazole (tapazole)**; they block the synthesis of T3 and T4.
 - Radioactive iodine therapy
 - Subtotal thyroidectomy
- Nursing management
- Family teaching: home, school, community

Disorder of the Adrenal Gland: Congenital Adrenal Hyperplasia

- Incidence: 6-8:100,000 (may be much higher now d/t better diagnostic tools)
- Etiology (21-hydroxylase deficiency): this is an enzyme deficiency; autosomal recessive disorder; degree of the deficiency produces more or less severe effects; enzyme will not let them produce cortisol or aldosterone. When cortisol is down...it sends a message to brain that it needs more...brain sends out ACTH to stimulate cortisol and the byproduct of that is stimulation of the adrenal gland and the production of androgens. (look this up)
- Pathophysiology
 - End up with decreased cortisol levels, increased ACTH. In the process, you get prolonged secretion of the ACTH causes hyperplasia of the adrenal glands. The steroids come from the adrenal glands....this causes excessive androgens to be produced.

- If you have excessive androgens in utero...the male baby will be normal or enlarged...with females it looks like they have a penis.
- Unable to synthesize aldosterone (aldosterone is used to retain Na and H₂O). This baby is going to be dehydrated and losing Na...this is "salt-wasting".
- Clinical manifestations
 - NB Male fetus: no physical changes to genitalia
 - NB Female fetus: virilized external genitalia
 - Enlarged clitoris
 - Fusion of the labial folds
 - Rugate appearance to labia
 - Pseudohermaphroditism
 - Children (often toddlers present): adrenarche, accelerated growth velocity, advanced bone age, acne, hirsutism
 - ↓ Na and cortisol levels, ↑ K levels
- Prenatal Diagnosis: can diagnose in utero and can treat from the 5th week on.
 - Dexamethasone is given to mom...this is a steroid....baby doesn't get bombarded with the ACTH and baby does fine.
- NB Diagnosis:
 - CA newborn screening
 - Labs: check for cortisol, Na, K, ACTH
 - Physical exam
 - Ultrasonography to check for ovaries and uterus.
- Treatment of NB
 - Sex assignment
 - Hydrocortisone or dexamethasone to replace cortisol
 - Florinef (fludrocortisone) to replace aldosterone....don't want baby to get hyponatremia d/t salt wasting or dehydration.
 - Surgery...very controversial
- Diagnosis
 - On California Newborn Screen
 - Confirmed through lab work & physical exam
 - Ultrasonography

Disorder of the Pancreas: Diabetes Mellitus: Type 1

- Recent research is indicating that genetics plays a role...a lack of Rfx6 gene failing to generate most of the normal cells in the pancreas including the beta cells.
- Incidence
 - 2nd most common chronic disease of childhood
 - 0.15/1000
 - Most commonly occurs during puberty
- Etiology
- Genetics plus virus = DM
- Lack of the Rfx6 gene failed to generate most of the normal cells in the pancreas including the beta cells

Diabetes Mellitus: Type 2

- Increasing # of diagnoses
- Body is unable to use insulin effectively
- Glucose accumulates in blood
- Body cannot efficiently use main source of fuel
- Cardinal signs
 - Polyphagia
 - Polyuria
 - Polydipsia
 - Weight loss

Treatment of Diabetes Mellitus

- Insulin management in children
 - BMR is very high in infants and toddlers
 - Insulin will work faster when BMR is higher..the onset will move up one category because of this...the fast acting will be super fast, etc...
 - If < 4 giving injection in buttocks (new research); > 4 then giving same as adult
- Blood glucose management
- Nutrition
- Exercise
- Nursing Management: Peds floor
 - Fluid balance
 - Insulin
 - Glucose Monitoring
 - Teaching
- Nursing Management: DKA
 - Life-threatening
 - Requires immediate intervention
 - Complications
 - Goal of treatment
 - Causes
 - Triggers
- Nursing diagnoses
 - Risk for injury related to insulin insufficiency and deficiency
 - Risk for injury related to hypoglycemia or hyperglycemia
 - Disturbed body image related to developing a chronic disease
 - Deficient knowledge related to management of Type I diabetes
 - Interrupted family processes related to management of a chronic illness

Developmental Considerations of DM

- Infant
 - Physiologic issues:
 - polyuria...parents may not notice the heavier diapers; baby may not be satisfied with breastmilk and may want water instead
 - the A1C is inaccurate for the first year of life
 - By the time the infant comes in they are in major hyperG and acidosis
 - Use cotton balls in diapers to get urine for ketones
 - How much insulin? Tiny tiny amounts...very small room for error. Pharmacy will dilute 1:1 so that if parent makes mistake it won't be so drastic.
 - Babies are very strong...use blanket as a restraint.
 - Use fingers for blood samples (use sides of pads, but fingers are tiny!). Can also use sides of toes as long as they are not walking!
 - Infants do not demonstrate hypoG type symptoms (don't sweat, etc...) Child will start out irritable and then quickly go to lethargy.
 - Erikson's stage: Trust vs. Mistrust
 - Key way to establish trust is get the infant's needs met by primary caregiver
 - This person has to start inflicting pain on the infant
 - Infant can sense when parents are nervous or anxious
 - Parent needs to comfort child after needle sticks, lots of hugs and cuddles.
 - BG target range:
 - Do not want tight control of BS...target for Type 1 DM infant is 100-200 before eating; 200-300 post prandial.
 - More risk for child to go hypoG...the child is moving around a LOT and using up their glucose. Note that exercising muscle does not need insulin to utilize glucose.

- If < 100, give 2-4 oz of glucose water or fruit juice; if too listless to drink can put a gel on the mucosa; if out of the gel can use cake frosting in an emergency; if there is a chance for aspiration then you go the IM (SQ?) glucagon route.
- TODDLER
 - Physiologic issues:
 - Early sign is that child starts having wetting accidents. Kids often come in for r/o UTI or they have UTI.
 - Very very thirsty; parents might withhold water thinking the kid is wetting the bed b/c they are drinking too much at bedtime. Parents will feel guilty when they find out!
 - Erikson's stage: Autonomy vs. Shame and Doubt
 - Child needs to be doing his own thing, needs to be exploring. Parent will not want to let child out of their sight and restrict them, causing a conflict.
 - When hypoglycemic, a temper tantrum could be a sign of this...but could also be normal toddler stuff. Check the blood sugar first!
 - Child is also very frightened of painful procedures; prep supplies away from the child.
 - Want to foster the child's autonomy by giving them a choice they can make...ask them which finger they want to use for stick.
 - Child mimic in this stage...so parents need to model being comfortable and relaxed with the procedure.
 - Lots of hugs and kisses afterwards; no toys!
 - Toddlers are picky eaters...give insulin after they eat.
 - BG target range:
 - If hypoglycemic (< 80), need to get some sugar in them stat! 2-4 oz of juice ASAP.
 - Ditto for gel and cake frosting if need be...can do glucagon if risk for aspiration
 - Target range is same for infant..
- PRESCHOOL
 - Erikson's stage: Initiative vs. Guilt; also doing magical thinking at this age. Will think this is a punishment for some kind of real or imagined wrongdoing.
 - Child needs to feel a sense of accomplishment...include him in this process.
 - Use play therapy...give child a doll with needle-less syringe so they can pretend.
 - Tell them the finger sticks and injections are going to hurt and that it's ok to cry.
 - Physiologic issues:
 - need to fill in
 - BG target range:
 - 70-180 before meals; 120-220 after meals
- SCHOOL AGED
 - Physiologic issues:
 - Will take frequent trips to the bathroom
 - Erikson's stage: Industry to inferiority; needs to be involved; should be able to do monitoring by 6 years of age.; by 9 should be able to do own injections; this age group uses manipulation and may lie and say their numbers are good even if they're not....may water down urine also.
 - These kids are involved in sports a lot...so will need more insulin in months when not as active.
 - BG target range:
 - 70-150 before meals; 120-200 after meals
 - Accept the condition more readily than do adolescents
- ADOLESCENT
 - Physiologic issues:
 - Eating disorders can come into play
 - Peer pressure
 - Nutrition, may feel restricted and resentful
 - Alcohol increases blood sugar...child needs to eat something if going to drink alcohol.
 - Tell them how DM affects the here and now.
 - Erikson's stage: Identity vs. Role Confusion
 - Adolescents appear to have the most difficulty adjusting

Hockenberry, Marilyn J.. *Wong's Essentials of Pediatric Nursing*. Seventh Edition ed. St. Louis: Mosby, 2005. Print.

Parsh, B. (2010, March 11). Pediatric Endocrinology. Pediatric Nursing. Lecture conducted from CSU Sacramento, Sacramento

Sampson, J (2010, March 11). Pediatric Endocrinology. Pediatric Nursing. Lecture conducted from CSU Sacramento, Sacramento.

Tobar, K. (2010, March 11). Pediatric Endocrinology. Pediatric Nursing. Lecture conducted from CSU Sacramento, Sacramento.