**The Endocrine System**

The endocrine system is the second regulating system of the body.

The endocrine system (slower than CNS) is made up of glands that secrete hormones into the bloodstream to slowly control bodily activities.

CNS: Central Nervous System is the primary regulating system of the body.

(Endo: inside / Exo: exterior)

Endocrine glands include:

Hypothalamus: links the nervous system to the endocrine system via the pituitary. All vertebrate brains have one, in humans it is roughly the size of an almond.

Pituitary: protrusion off the bottom of the hypothalamus. AKA – hypophysis. Size of a pea, secretes 9 hormones.

Pineal: located near the center of the brain, regulates sleep/wake cycle (circadia rhythm). pine cone, hence the name pineal

Thyroid: One of the largest endocrine glands. Located in the neck on either side of and just beneath the Adam’s apple. Controlled by the pituitary. It can store hormones.

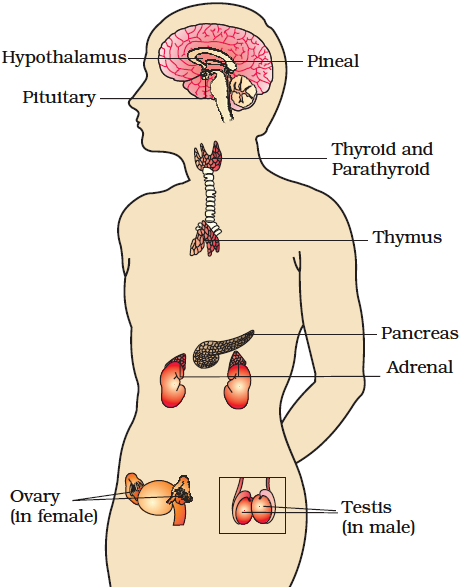
Parathyroid: size of a grain of rice. Located on near the surface of the thyroid, humans usually have 4. Occasionally someone may have 6 or even 8 and rarely they can be found elsewhere in the body (usually in chest).

Thymus: located between heart and sternum. Most active in neonates through adolescents. Begins to atrophy by early teen years. Important in development of immune system.

Adrenal: sit atop the kidneys. In humans the right is triangular and the left is semi-lunar.

Pancreas: gland/organ that plays a role in the endocrine, exocrine, and digestive system.

Gonads: women have ovaries – estrogen, progesterone, men have testosterone.



Diabetes Mellitus

Diabetes Mellitus is a group of diseases marked by hyperglycemia and abnormal metabolism of fat, carbohydrate and protein that lead to micro vascular, macro vascular and neuropathic complications. Insulin action and secretion are often impaired with diabetes patients.

The Centers for Disease Control and Prevention estimate that 18.3 million people in the United States have diabetes and 5 million are undiagnosed.

Diabetes is the 6th leading cause of death in the United States probably because diabetes patients are 2 to 4 times more likely to develop heart disease and stroke as secondary conditions.

Diabetes Mellitus is broken down into Type 1, Type 2 and Gestational Diabetes.

* Type 1 Diabetes Mellitus is the result of the body destroying its own beta cells in the pancreas so no insulin is secreted from the pancreas. Patients with this type of diabetes must receive insulin injections.
* Type 2 Diabetes Mellitus is characterized by lowered beta cell activity, insulin resistance or increased glucose production by the liver. Patients with Type 2 Diabetes Mellitus will eventually require insulin injections as well.
* Gestational diabetes is abnormal glucose tolerance during pregnancy. Gestational diabetes mellitus occurs in about 135,000 cases per year, and does not include women who already have diabetes prior to pregnancy.

Glucose is the main energy source for the body.

Alpha cells release glucagon which increases blood glucose.

Beta cells produce and secrete insulin in a tightly regulated manner.

Medical Terms

* Hypo- = beneath, insufficient
* Hyper - = excessive
* Hyperglycemia - having a fasting plasma glucose greater than 100 mg/dL.

(Not necessarily diabetes)

Drug Class: Insulins

* Insulin is a hormone produced by the beta cells in the pancreas.
* Insulin is important for metabolism and is needed for glucose to enter skeletal muscle, heart muscle and fat.
* Since animal pancreases have similar actions as human pancreases, beef and pork insulins were used for many years. Nowadays, biosynthetic insulins are available and have less allergy side effects as the beef and pork insulins.

**Rapid-Acting Insulin**:

* **NovoLog** (aspart - generic) Route: SC. Side effects: hypoglycemia(low blood sugar), hypokalemia(low potasium), injection site reactions, lipodystrophy, pruritis, rash.
* **Humalog** (lispro - generic) Route: IV, SC. Side effects: hypoglycemia, hyperglycemia, hypomagnesemia(low magnesia), hypokalemia(low potasium), rash, urticaria, pruritis(severe itching), swelling, redness, stinging, warmth at injection site, lipoatrophy, lipohypertrophy(limp or fatty issue under the skin), hypersensitivity reactions, anaphylaxis.

**Short-Acting Insulin: (Onset 30 minutes – pik 3 hours – duration 8 hours)**

* **Humulin R** (regular insulin) Route: IV, SC. Side effects: hypoglycemia, hyperglycemia, hypomagnesemia, hypokalemia, rash, urticaria, pruritis, swelling, redness, stinging, warmth at injection site, lipoatrophy, lipohypertrophy, hypersensitivity reactions, anaphylaxis.
* **Novolin R** (regular insulin) Route: IV, SC. Side effects: Same as above.

**Long Acting Insulin: (Onset 1 hour – pik 6 hours – duration 12 hours)**

* **Lantus** (glargine - generic) Route: SC. Side effects: hypoglycemia, lipo dystrophy, pruritis, rash, allergic reactions, pain at injection site.

Drug Class: **Biguanide** Oral Antidiabetic Agents

3 ways Biguanide Antidiabetic Agents reduce blood sugar:

1. Less out of the liver

2. Less from food

3. More on storage

* Decreases hepatic glucose production by slowing glycogenolysis and gluconeogenesis, lowers absorption of glucose from the small intestine and improves glucose uptake in peripheral muscle and adipose cells.
* **Glucophage** (metformin - generic) - Route: P.O. Side effects: diarrhea, nausea, vomiting, abdominal bloating, flatulence, anorexia, unpleasant or metallic taste, megaloblastic anemia, lactic acidosis.

Drug Class: **Sulfonylurea** Oral Hypoglycemic Agents

* Lowers blood glucose by stimulating the release of insulin from the beta cells of the pancreas.
* Lowers glucose production and metabolism of insulin by the liver.
* **Diabinese** (chlorpropamide- generic) - Route: P.O. Side effects: paresthesia(numbness or tingling), fatigue, dizziness, vertigo, malaise (feeling like crap), headache, increased risk of cardiovascular mortality, tinnitus, nausea, heartburn, epigastric distress(upset tommy), tea-colored urine, leukopenia(low white blood cells), thrombocytopenia(low level of platelets), aplastic anemia, agranulocytosis(low white blood cells severe), hemolytic anemia(Anemia due to the destruction, rather than underproduction, of red blood cells), cholestatic jaundice, prolonged hypoglycemia, dilutional hyponatremia(low sodium levels on the blood), rash, pruritis, erythema(redness of the skin), urticaria, hypersensitivity reactions.(allergy)
* **Amaryl** (glimepiride - generic) - Route: P.O. Side effects: dizziness, asthenia(generalized weakness, muscle weakness), headache, nausea, hemolytic anemia, leukopenia, agranulocytosis, thrombocytopenia, aplastic anemia, pancytopenia(low of everything in the blood), cholestatic jaundice, hypoglycemia, dilutional hyponatremia, pruritis, erythema, urticaria, morbilliform(rush that look like missles) or maculopapular eruptions, photosensitivity reactions.
* **Glucotrol** (glipizide - generic) - Route: P.O. Side effects: dizziness, drowsiness, headache, nausea, constipation, diarrhea, leukopenia, hemolytic anemia, agranulocytosis, thrombocytopenia, aplastic anemia, cholestatic jaundice, hypoglycemia, rash, pruritis, photosensitivity.
* **Glynase** (glyburide - generic) - Route: P.O. Side effects: blurred vision, nausea, epigastric fullness, heartburn, leukopenia, hemolytic anemia, agranulocytosis, thrombocytopenia, aplastic anemia, cholestatic jaundice, hepatitis(irritation of the liver), hypoglycemia, arthralgia(joint pain), myalgia (muscle pain), rash, pruritis, angioedema, other allergic reactions.

Drug Class: **Meglitinide** Oral Hypoglycemic Agents

* Lowers blood glucose by stimulating release of insulin from beta cells of the pancreas.
* **Starlix** (nateglinide - generic) - Route: P.O. Side effects: dizziness, diarrhea, hypoglycemia, back pain, arthropathy, upper respiratory tract infection, bronchitis, coughing, flu symptoms, accidental trauma.
* **Prandin** (repaglinide - generic) - Route: P.O. Side effects: headache, paresthesia, angina, rhinitis, sinusitis, constipation, diarrhea, dyspepsia, NV, urinary tract infection, hypoglycemia, hyperglycemia, arthralgia, back pain, bronchitis, upper respiratory tract infection, tooth disorder(root of the teeth affected by).

**Thyroid Diseases**

* Hypothyroidism occurs as the result of insufficient thyroid hormone production.
* Myxedema is hypothyroidism that happens during adulthood. Onset of symptoms is mild. Patients develop slowness in motion, speech and mental processes, become lethargic, have decreased appetites, gain weight and tire easily.
* Congenital hypothyroidism occurs when a child is born without a thyroid gland.
* Hyperthyroidism is excessive production of thyroid hormones. Patients with hyperthyroidism have rapid heart rates, cardiac enlargement, palpitations, dysrhythmias, are easily agitated, have increased appetite but lose weight.

Drug Class: Thyroid Replacement Hormones

* **Hypothyroidism** is treated by replacing the deficient T3 and T4 hormones.
* **Synthroid**, **Levoxyl** (levothyroxine - generic) - Route: IV, P.O. Side effects: nervousness, insomnia, tremor, headache, tachycardia(rapid heart rate), arrhythmias(under heart rate), angina(chest pain), cardiac decompensation and collapse, diarrhea, vomiting, menstrual irregularities, weight loss, decreased bone density, allergic skin reactions, diaphoresis (excesive sweating), heat intolerance, fever.
* **Cytomel** (liothyronine sodium - generic) - Route: IV, P.O. Side effects: nervousness, insomnia, tremor, headache, tachycardia, arrhythmias, angina, cardiac decompensation and collapse, diarrhea, vomiting, menstrual irregularities, weight loss, accelerated bone maturation in infants and children, skin reactions, diaphoresis, heat intolerance.

**Math:**

1mL = 1cc

1mL = 100 units of insulin (u 100)

1cc = 100 units

1 unit = 1min (minim)

u100 = 1mL

1mL = 100min

1/2cc = 50min

Metric System

L - liters: volume a liquid

g – gram: weight of a solid

L to mL (liters to miliLiters) x1000

mL to L (miliLiters to Liters) /1000

g mg (grams to miligrams) x1000

mg to g (miligrams to grams) /1000

g to mcg (grams to microGrams) x1.000.000

mcG to g (microGrams to grams) /1.000.000

L to mL (cc) x1000

g to mg to mcg

x 1000 x1000

**Dosage Calculations**

D = desired amount (order)

H = have on hand (supply)

Q = quantity (directly related to supply)

D/H \* Q

Rx – prescription

Fx – fracture

Sx – surgery

Tx – treatment

Hx – history

QD – every day

QOD – ever other day

QID – 4 times per day

TID – 3 times a day

BID – 2 times per day

AC – Before meals

PC – after meals

NOC – at night

HS – hours of sleep/at bedtime

1. The physician orders Minipress 2 mg po two times a day for Mr. Shaw’s high blood pressure. How many capsules will the nurse administer per dose?

Supply: Minipress 1 mg capsules

2. Mrs. Taylor has a long history of seizures. Elixir of phenobarbital 30 mg po q12 h is ordered. How many milliliters will the nurse administer per dose?

Supply: Phenobarbital elixir 20 mg per 5 mL

3. Mr. Davis has a diagnosis of acute maxillary sinusitis. His physician orders Biaxin 500 mg q12h x 10 days. How many tablets will the nurse administer per dose?

Supply: Biaxin 250 mg tablets

4. The physician orders Pravachol 20 mg po at bedtime. How many tablets will the nurse administer per dose?

Supply: Pravachol 10 mg tablets

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|  |  | Module 8 Endocrine System Dosage Calculations |  |  |  |  |  |  |
| 1. Ibuprofen 400mg PO q6h prn is ordered for Mary's joint pain. | | | | | | | | |
| Supply: ibuprofen 0.2g | | | | | | | | |
| How many tablets will you give per dose? | | | | | | | | |
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| 2. The physician orders ibuprofen 0.6g for Mr. Jones' osteoarthritis. | | | | | | | | |
| Supply: ibuprofen 200mg tablets | | | | | | | | |
| How many tablets will you administer per dose? | | | | | | | | |
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| 3. Cimetidine 300mg is ordered for Mr. Smith's PUD (peptic ulcer disease). | | | | | | | | |
| Supply: cimetidine 100mg/5mL | | | | | | | | |
| How much will you give per dose? | | | | | | | | |
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| 4. Order: phenytoin (Dilantin) 0.09g PO, to be given through nasogastric tube. | | | | | | | | |
| Supply: phenytoin (Dilantin) 30mg/5mL | | | | | | | | |
| How many mL will you administer per dose? | | | | | | | | |
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| 5. Order: amoxicillin suspension 125mg q6h. | | | | | | | | |
| Supply: amoxicillin suspension 250mg/5mL | | | | | | | | |
| How much do you administer per dose? | | | | | | | | |