

Various endocrine organs and functions of each

| | |
|-----------------------------------|---|
| Hypothalamus (control/integrator) | releasing hormones to the anterior pituitary (blood communication) and direct connection to posterior pituitary (nerve communication) |
| Pineal gland | sleep |
| Pituitary gland | 1st hormones to body organs |
| Pancreas | Insulin and glucagon |
| Thyroid gland | Parafollicular cells, high blood calcium, storage of calcium in bone |
| Parathyroid gland | low blood calcium, parathyroid hormone (pth), release calcium into blood from bone |

Pituitary gland

| | |
|----------------|---|
| Adrenal glands | stress response, blood pressure response, blood osmolarity, sex hormones |
| Thyroid gland | follicular cells, release thyroid hormone (t3 and t4) to increase metabolism and body temperature |
| Mammary gland | secretion of milk for offspring |

Pituitary gland (cont)

| | |
|-----------------------------|---|
| Testes | make and release testosterone |
| Ovaries | make and release estrogen and progesterone |
| Melanocytes | makes melanin, protection from UV rays |
| Ductus deferens | orgasm response, semen |
| Uterine and vaginal muscles | orgasm response, childbirth |
| Liver | blood sugar regulation and storage, growth hormone signaling to muscle and bone |
| Bone | growth hormone cycle |
| Muscle | growth hormone cycle, glucose storage |
| Kidneys | water and blood pressure |

Steroid and non-steroid hormone mechanisms

What are characteristics of steroid hormones?

lipid so they enter the cell and go into the nucleus and target DNA to make new proteins

What are characteristics of a non-steroid hormone?

do not enter cell, interact with surface proteins -> secondary messenger internally in the cell to cause response (signaling cascade)

T3T4 production for thyroid gland (hypothalamus)

Temp/metabolism feedback loop

Low metabolism - low T3T4, low body temp

T3T4 production for thyroid gland (hypothalamus) (cont)

TRH -> TSH -> follicular cells release the follicle containing T3 and T4 -> increase metabolism

Thyroid Follicular Cells and Parafollicular Cells

| | |
|----------------|----------------------------|
| Parafollicular | High calcium |
| Follicular | Low metabolism (T3 and T4) |

Layers of Adrenal Gland

Cortex

Zona glomerulosa stress response - cortisol

Zona fasciculata low blood volume - aldosterone

Zona reticularis DHEA and androsterone, precursors to sex hormones

Medulla stress response - epinephrine and norepinephrine

Basic Knowledge for Multiple Choice

Know the effects of the renin-angiotensin-aldosterone system and how it regulates blood volume and blood pressure in detail

Know how ACE inhibitors work

Know how ADH works and how it regulates blood osmolarity and blood pressure



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Diabetes mellitus (I and II) effects on bg

| | |
|--|---|
| Type I | no production of insulin |
| Type II | we may or may not make insulin and body cells no longer respond to insulin - insulin resistance |
| Insulin beta cells use glucose so we can't control high glucose levels | Low levels can cause diabetic coma |

Endocrine Pathology

| | |
|------------------|---|
| Hypert-hyroidism | High thyroid activity - weight loss, etc., cushing's syndrome, insomnia, hyperactivity |
| Hypoth-yroidsim | A lack of temp. control, weight gain, hair loss, lethargy, etc. |
| Diabetes | sugar in urine (sweet urine) |
| Inspidus | Kidneys processing too quickly, water goes through too fast, excessive urination, dehydration |
| Mellitius | insulin issues |

Endocrine System

What are the similarities of the endocrine and nervous systems?

Both control systems (homeostasis and other)

What are some differences of the nervous and endocrine systems?

Mode of communication (endo- hormones nerv- electrical signals)
 Speed of response (endo- slow nerv- fast)
 Duration of change/response (endo- longish term nerv- gone fast)

Blood Glucose Feedback Loop

| | |
|-------------------|--|
| Stimulus | Increased blood glucose |
| Sensor/Integrator | Pancreatic Beta cells |
| Hormone Released | Insulin |
| Effector | Liver and skeletal muscle |
| Response | Liver and skeletal muscle uptake glucose -> glycogen |
| Result | Decrease In blood glucose and return to homeostasis |

Growth Hormone Feedback Loop

| | |
|-------------------|-------------------------------------|
| Stimulus | Low blood glucose, sleep, or stress |
| Sensor/Integrator | Hypothalamus |
| Hormone Released | GHRH |
| Target | Anterior Pituitary Somatotropes |

Growth Hormone Feedback Loop (cont)

| | |
|------------------|---|
| Hormone Released | GH |
| Effector | Liver, bones, muscles, fat cells |
| Response | Increase blood glucose, cell growth and proliferation, bone length, muscle mass, lipolysis. Decrease glucose uptake |
| Result | Return to homeostatic blood glucose levels and growth and repair of the body |

Calcium Feedback Loop (High)

| | |
|-------------------|--|
| Stimulus | Increased blood Ca^{2+} |
| Sensor/Integrator | Parafollicular cells in thyroid gland |
| Hormone released | Calcitonin |
| Effectors | Osteoblasts |
| Responses | Osteoblasts activity increases = put calcium into bone |
| Result | Blood calcium level decreases back to normal |

Calcium Feedback Loop (Low)

| | |
|-------------------|---------------------------|
| Stimulus | Decreased blood Ca^{2+} |
| Sensor/Integrator | Parathyroid glands |
| Hormone released | PTH |



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Calcium Feedback Loop (Low) (cont)

| | |
|-----------|--|
| Effectors | Osteoclasts, kidneys, intestines |
| Responses | Osteoclasts degrade bone matrix which releases calcium into blood, kidney (reabsorb Ca) targets liver which releases Vit. D. Vit D to intestines absorb more calcium |
| Result | Calcium blood return to normal range |

Calcium Feedback Loop (Low)

| | |
|-------------------|--|
| Stimulus | Decreased blood Ca^{2+} |
| Sensor/Integrator | Parathyroid glands |
| Hormone released | PTH |
| Effectors | Osteoclasts, kidneys, intestines |
| Responses | Osteoclasts degrade bone matrix which releases calcium into blood, kidney (reabsorb Ca) targets liver which releases Vit. D. Vit D to intestines absorb more calcium |
| Result | Calcium blood return to normal range |

Metabolism Feedback Loop

| | |
|-------------------|--|
| Stimulus | Decrease in T3 and T4 concentrations |
| Sensor/Integrator | Chemo and temp receptors, Hypothalamus |
| Hormone Released | Hypothalamus releases TRH |
| Target | Anterior pituitary |
| Hormone released | TSH |
| Target | Thyroid gland (follicular cells) |
| Hormone released | Thyroid gland released T3 and T4 |
| Effector | Body tissues |
| Response | Increased metabolic activity |
| Result | Return to homeostatic body temperature, increase in energy |

Lymphatic System

| | |
|---|--|
| What are characteristics of the lymphatic system? | Vessels, nodes, and accessory organs filled with water like fluid |
| What is the purpose of the lymphatic system? | To return free fluid in the body back to the blood, houses and matures the WBC |

Function of Lymphatic sys. & Accessory

| | | |
|----------|---|--|
| Vessels | Vessels, trunks, ducts | Absorption of interstitial fluid and transportation of lymph |
| Nodes | Structures that house and allow for storage of an maturation of lymphocytes | Monitor lymph fluid for pathogens |
| Thymus | where T cells mature | |
| Spleen | Where we send red blood cells to be recycled , storage of WBC | |
| Lacteals | in the intestine microvilli fat absorption | |
| MALT | nodules to monitor incoming solutes for pathogens, in mucosa | |

Lymph Drainage

| | |
|----------------------|--|
| Right lymphatic duct | right lymphatic vessels of the right facde, right neck, right arm, right axillary and cervical lymph nodes |
|----------------------|--|



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Lymph Drainage (cont)

Left lymphatic duct aka thoracic duct

All remaining lymph vessels and nodes of the upper body and the total lower body. Left cervical, left axillary, I+r iliac, I+r inguinal lymph nodes

Role of the lymphatic sys. in immune response

House and mature many white blood cells, we transport WBC from tissues back into circulation, nodes monitor cells and pathogens that travel through

Erythrocyte recycling

Break down old RBC with the spleen and liver, dispose of bilirubin as bile, reuse iron to make new RBC

Blood

What are general characteristics of blood?
Fluid, proteins, cells

Functions of blood

Transportation: Gases, nutrients, hormones, WBCs (immune response throughout the body)

Blood recipient prob and erythroblastosis fetalis

Agglutination with the wrong type blood - destroy blood, death

Blood recipient prob and erythroblastosis fetalis (cont)

Mother is Rh- and has been exposed to positive blood/antigen, has made antibodies against Rh+, will attack fetus

Clotting Disorders

Lack of platelet production = no clot = thrombocytopenia

Hemophilia - genetic disorder that stops/lacks conversion of clotting factors

Thrombus and Embolus

Thrombus: Clot forming where it does not belong, usually in an artery with cholesterol crystal deposits

Embolus: Thrombus dislodging from the clot, can block a vessel somewhere else in the body, i.e. pulmonary embolus

Steps of Hemostasis (basic steps)

Vascular spasms: let a ton of blood in the area to provide platelets

Platelet plug: platelets start to stick together and adhere to endothelium and CT

Coagulation:
1. Prothrombin activator released by damage
2. PA converts prothrombin into thrombin
3. Thrombin converts fibrinogen into fibrin (insoluble - not dissolvable)

Anemia and Polycythemia

Anemia: low O₂ to tissues

Hemorrhagic anemia: caused by blood loss

Hemolytic anemia: excessive RBC destruction with low hematopoiesis

Aplastic anemia: bone marrow is not functioning enough (during and after chemo)

Iron deficient: not enough iron to make hemoglobin

Sickle Cell anemia: inherited Hb mutation

Polycythemia: high RBC - blood is too viscous/thick dec. O₂ delivery to tissues, lead to clots

Components of blood and plasma

Plasma: proteins (albumins [most abundant], globulins, fibrinogen), water, solutes (ions, waste, gases, regulation molecules/hormones)

Formed elements: cells and others

Erythrocyte: transportation of gases

Leukocytes: Immune response

Platelets: Blood clotting



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RBC Count

Low RBC Tired/lethargy, dizziness/light headedness, increased heart rate, headaches, shortness of breath, pale skin

Extra RBC but not too high Blood doping, inc. O₂ carrying capacity, decreases fatigue, inc. performance

High RBC (low plasma - dehydration) Fatigue, shortness of breath, insomnia, itchy skin

Hematocrit

% of formed elements specifically RBC

Estimate of oxygen carrying capacity

Hematopoiesis Feedback Loop

Stimulus Decreased O₂ to tissues

Sensor/integrator Kidney

Signal released Erythropoietin

Effector Spongy bone - red bone marrow

Response Make RBC

Result Inc. delivery of O₂ to tissues back to homeostasis

Hematopoiesis

Making of blood cells - differentiation of stem cells Myeloid stem cells (makes RBC, platelets, basophils, eosinophils, neutrophils, monocytes). Lymphoid stem cells (lymphocytes)

Red bone marrow in spongy bone

Structure of Hb Subunits

Alpha chains x2

Beta chains x2

Each chain forms around an iron molecule (Fe) (1 Heme = chain + Fe)

4 heme = hemoglobin

1 heme carries 1 O₂

1 hemoglobin - carries 4 O₂

Hb binding affinity for O₂ and CO₂

| | | | |
|--------------|--|---|---|
| Lungs | pH - high pH -> inc. O ₂ affinity and binding | Temp - cold -> inc. O ₂ affinity and binding | Partial Pressure - lots of O ₂ -> inc. O ₂ affinity and binding |
|--------------|--|---|---|

Hb binding affinity for O₂ and CO₂ (cont)

| | | | |
|---------------------|---|---|--|
| Body tissues | pH - low pH -> dec. O ₂ affinity and binding allow CO ₂ binding | Temp - lots of metabolism inc. heat -> dec. O ₂ affinity and binding allow CO ₂ binding | Partial Pressure - lots of CO ₂ -> dec. O ₂ affinity and bonding |
|---------------------|---|---|--|

Facts for RBCs

About 44% of blood

4-7million/mm³ in an adult

Live for about 120 days

Anucleate at maturity

Purpose of RBC Shape

Biconcave increases surface area to increase diffusion for transportation

How does sickle cell anemia affect the shape? changes the surface area of the cell, changes the Hb folding, holding/transporting less material, the hook shape can get stuck together more easily causing clots



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Lymphocytes

| | |
|----------|--|
| B cells | antibody making memory cells, pathogens we have come across before (bacteria, virus, etc.) |
| T cells | memory cells that target the cells or other pathogens that are foreign directly |
| NK cells | cancer killers, destroy abnormal cells |

Leukocytes

| | |
|-------------|--|
| Neutrophils | innate immunity, bacterial infection |
| Lymphocytes | adaptive immunity |
| Monocytes | innate immunity, but will follow b cell orders or antibody flags, macrophage, usually stay in peripheral tissues |
| Eosinophils | innate immunity, parasites |
| Basophils | damage identifying cells, increase inflammation and blood flow to damaged but not bleeding areas |



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