ANATOMY II
LAB PRACTICAL II
SI REVIEW
THE ENDOCRINE SYSTEM

Major Glands
What Hormones they Release
The Class of Chemical
What is the Trigger for Each
What is the Target
Hormones: Hypothalamus

- Promotes TSH and PRL Secretion: 1
- Promotes ACTH Secretion: 2
- Promotes FSH and LH Secretion: 3
- Promotes PRL Secretion: 4
- Inhibits PRL Secretion: 5
- Promotes GH Secretion: 6
- Inhibits GH and TSH Secretion: 7

- All class of hormones from this gland are peptide/protein based hormones
- All hormones from this gland are topic (see below for discussion)
## Hormones: Anterior Pituitary

<table>
<thead>
<tr>
<th>Target</th>
<th>Hormone</th>
<th>Ends up</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Ovaries and testes</td>
<td>1</td>
<td>→ Exocrine</td>
</tr>
<tr>
<td>2. Ovaries and testes</td>
<td>2</td>
<td>→ Endocrine</td>
</tr>
<tr>
<td>3. Thyroid gland</td>
<td>3</td>
<td>→ T&lt;sub&gt;3&lt;/sub&gt;/T&lt;sub&gt;4&lt;/sub&gt;</td>
</tr>
<tr>
<td>4. Adrenal Cortex</td>
<td>4</td>
<td>→ Corticosteroids</td>
</tr>
<tr>
<td>5. Mammary Glands</td>
<td>5</td>
<td>→ Exocrine</td>
</tr>
<tr>
<td>6. Liver, bone, muscle</td>
<td>6</td>
<td>→ Tissue growth</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- All hormones released by the Anterior pituitary are peptide/protein based hormones
- #6 has both tropic and non-tropic effects
### Hormones: Posterior Pituitary

<table>
<thead>
<tr>
<th>Target and effect</th>
<th>Hormone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kidneys (collecting ducts); conserve water –</td>
<td>1</td>
</tr>
<tr>
<td>Uterus, mammary glands, brain, --</td>
<td>2</td>
</tr>
</tbody>
</table>

“Make more Aquaporins!”

- These protein based hormones have neuronal triggers (see below)
## Hormones: Thyroid

<table>
<thead>
<tr>
<th>Effect</th>
<th>Hormone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increases Body Metabolism –</td>
<td>1</td>
</tr>
<tr>
<td>Responds to Hypercalcemia --</td>
<td>2</td>
</tr>
</tbody>
</table>

- The thyroid has both hormonal (follicular cells) and humoral (C cells) responses
- Follicular cells release monoamines, C cells release peptide based hormones
**Hormones: Parathyroid**

<table>
<thead>
<tr>
<th><strong>Trigger</strong></th>
<th><strong>Hormone</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Responds to Hypocalcemia –</td>
<td>1</td>
</tr>
</tbody>
</table>

- This hormone works by promoting the synthesis of calcitriol from the kidneys which promotes calcium intestinal calcium absorption, inhibition of urinary excretion of calcium, and indirectly simulating osteoclasts to resorb bone.
Hormones: Thymus

- This gland involutes (shrinks) with age
- Its hormones play a role in development and maturation of T-lymphocytes
Hormones: Adrenal Medulla

• These hormones are released due to a stimulation of the sympathetic nervous system.
• The cells in this gland are modified postganglionic sympathetic and are called chromaffin cells.

1. What hormones are released?
2. Name the cells which make up the adrenal medulla.

- These monoamine hormones have a neuronal trigger.
## Hormones: Adrenal Cortex

<table>
<thead>
<tr>
<th>Category of Hormone</th>
<th>Example Hormone and layer</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mineralocorticoids</td>
<td>1</td>
<td>$\uparrow$ Na(^+) pumps</td>
</tr>
<tr>
<td>Releases Glucocorticoids</td>
<td>2</td>
<td>$\downarrow$ inflammation</td>
</tr>
<tr>
<td>Releases Gonadocorticoids</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

- Glucocorticoids and Gonadocorticoids have tropic triggers (ACTH from the anterior pituitary)
- Each hormone made and released by this gland are steroids
## Hormones: Pancreas

<table>
<thead>
<tr>
<th>Trigger</th>
<th>Hormone - Specific Cell</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyperglycemia</td>
<td>1 - β cells</td>
<td>2</td>
</tr>
<tr>
<td>Hypoglycemia</td>
<td>3 - α cells</td>
<td>4</td>
</tr>
</tbody>
</table>

- These are antagonistic hormones controlling glucose homeostasis in blood
- These protein based hormones have humoral triggers
Hormones: Gonads (male)

**Hormone**

- Interstitial cells produce and release: **testosterone**
- Responsible for male secondary sex characteristics and libido

> The testis are dual endocrine/exocrine
> Tropic trigger and releases steroids
Hormones: Gonads (female)

Hormones Released from the Ovaries

- Granulosa cells release estrodiol in the first half of the menstrual cycle.
- After ovulation, the corpus luteum produces the above hormone and progesterone.

The ovaries are dual endocrine/exocrine
- Tropic trigger and releases steroids.
Hormones: Pineal Glands

- The function of this gland is to regulate circadian rhythm.
- Serotonin is release during the day and melatonin is released at night.
- Both of these hormones fall under the class of monoamines and have neuronal triggers.

- These hormones are monoamines and have a neuronal trigger.

![Pituitary and Pineal Glands](image)
Endocrine Lab Picture

1. Posterior Pituitary
2. Anterior Pituitary
3. Parathyroid
4. Thyroid
5. Adrenal Glands
6. Pancreatic Islets
7. Gonads: Testis
8. Ovary
Formed Elements of Blood

Platelets

Differential White Blood Cell Count

Hematocrit
**Formed Elements: Erythrocytes**

**Function:**
- Hemoglobin within the cell transport mostly $O_2$ and some $CO_2$

**Characteristics:**
- Most numerous of the formed elements
- Biconcave Disk
- Only lives about 100-120 days

*4.8 million/µL in females*

*5.4 million/µL in males*
General Characteristics of Leukocytes: Granulocytes

- **Neutrophil:** 3-5 lobed nucleus  
  - 60–70% of all WBCs  
  - Most numerous (seen first at sight of infection)  
  - Releases a cocktail of chemicals to kill bacteria  
  - Will self destruct when outnumbered by pathogens  

**Identification Characteristics:**  
- Multi-lobed nucleus

- **Eosinophil:** Bi-lobed nucleus  
  - 2–4% of all WBCs  
  - Seen in high amounts during parasitic infection (they secrete chemicals to destroy parasites/worm)  
  - Phagocytizes antigen-antibody complexes  
  - Seen in higher amounts during worm infestation!  

**Identification Characteristics:**  
- Bi-lobed Nucleus  
- Has a rosy pigment
General Characteristics of Leukocytes: Granulocytes

- **Basophil**: cannot see nucleus due to being obscured by many granules  
  0.5–1% of all WBCs

  Appear in many kinds of inflammatory reactions
  Secretes chemicals to affect localized blood flow:
  *histamine* (vasodilator)
  *heparin* (anticoagulant: prevents blood clotting)
General Characteristics of Leukocytes: Agranulocytes

• **Lymphocyte:** the specialists of the immune system
  - Targets “bad cells” like cancer and virally infected cells
  - B-lymphocyte = plasma cells secrete antibodies,
  - T-lymphocytes = Cytotoxic, Helper, and Memory T cells
  - Natural Killer Cells = checks a certain antigen on the cell surface called a “self-molecule”

• **Monocyte:** the cleanup crew
  - Grows up to be a macrophage
  - Eats anything that isn’t supposed to be there: debris, invaders, pathogens (after becoming macrophage)
Leukocytes

1.

2.
2. Lymphocyte

1. Neutrophil
Leukocytes

1. Monocyte

2. Lymphocyte
Leukocytes

1. Neutrophil
2. Monocyte
3. Lymphocyte
4. Neutrophil
2. Eosinophil
3. Lymphocyte
4. Basophil
Formed Elements: Platelets

- Also known as thrombocytes
- Fragments of a megakaryocyte in the red bone marrow
- Primary function is to help stop blood loss by forming a platelet plug

*Megakaryocyte: a stem cell producing platelets*
**Hemostasis**

1. **Constriction caused by:**
   - Neuronal reflex pain receptors
   - Local properties of smooth muscle
   - Local paracrine signaling
     - platelets releasing 5-HT (serotonin)

2. **Positive Feedback mechanism:**
   - Platelets stick to exposed collagen
   - Platelets degranulate and release ADP to attracts other platelets and thromboxane $A_2$
   - More serotonin released

3. **Positive feedback is in action until coagulation is completed**
Intrinsic and extrinsic pathways merge on fibrinogen (soluble protein) to form fibrin (insoluble protein), which completes the clot.
**FUNCTION:** Differential white blood cell count gives the relative percentage of each type of white blood cell and also helps reveal abnormal white blood cell populations (note the normal percentage is listed in blue in the above slides)

- Abnormal amounts will help determine the type of infection present

**Example:**

- Count 50 leukocytes, categorize them, then multiply 2. You will get X number of leukocytes out of a 100. 60% neutrophils is a normal count. 80% would indicate a bacterial infection!

Chances are
They will give You the numbers!
Hematocrit

- FUNCTION: to measure the percentage of Red Blood Cells in the body
- Denoting any abnormal conditions
ANATOMY OF THE HEART

Layers of the heart wall and pericardium

Inner Heart Anatomy
Layers of the Heart Wall and Pericardium

- The pericardium sits inside the mediastinum
- Strong fibrous pericardium, Serous membrane (parietal pericardium and visceral pericardium)
Anatomy of the Heart

1. 10. 11. 12. 13.
2. 14.
3. 15.
4. 16.
5. 17.
6. 18.
7. 19.
8. 20.
9. 21.
General Terminology
Systolic and diastolic pressures
Blood pressure
Heart Rate
Electrocardiogram
• **Systolic pressure:** the highest arterial blood pressure exerted on the arteries *(90-120 in adults)*

• **Diastolic pressure:** the lowest pressure in the arteries *(60 – 80 in adults)*

• **Pulse Pressure:** Systolic over diastolic pressures. It represents the force that your heart generates during each cardiac cycle.

• **Sphygmomanometer:** a device used to measure blood pressure

• **Electrocardiogram:** a transthoracic interpretation of the electrical activity of the heart over a period of time, as detected by electrodes attached to the surface of the skin

• **Auscultation:** the term for listening to the internal sounds of the body, usually using a stethoscope

• **Isovolumetric:** unchanging volume

• **Blood Pressure:** the force which the blood exerts on the walls of the blood vessels
• Cardiac output = heart rate X stroke volume

• The amount of blood ejected from the ventricles is equal to how many times your heart beats in a given amount of time multiplied by the blood ejected from the ventricles
**Conduction System of the Heart**

1. Right atrium
2. Right ventricle
3. Left atrium
4. Left ventricle

Normal ECG
Electrocardiogram
Electrophysiology of the Heart

• **FIRST:** understand what is happening during the electrocardiogram
• **SECOND:** from the ECG, know what the chambers are doing: systole/diastole
• **THIRD:** from knowing the contraction of the chambers, figure out the pressure that would be in each valve as it contracts and relaxes
• **FOUR:** from knowing the pressure, determine the position of the heart valves and flow of blood

Example:

1. During the P wave, a depolarization occurs in the atria which is then recorded on the ECG
2. This change in voltage across the atria indicates that slow voltage gated calcium was triggered and muscle contraction was initiated, the atria are in systole
3. Due to contraction of the atria, the pressure goes up
4. This pressure pushes just a little bit of blood into the ventricles, causing the AV valves to close because the pressure in the ventricles are now higher than the pressure in the atria
**P Wave** – records atrial depolarization and therefore atrial systole

**QRS Wave** – records atrial ventricular and therefore atrial ventricular

**T Wave** – records ventricular and therefore ventricular

**Quiescent Period** – records no electrical change, which indicated the ventricles being relaxed

**Electrophysiology of the Heart: ECG**
1. Which phase of contraction?
2. Which valve is doing what?
3. Which valve is doing what?
4. Which phase of relaxation?
5. Which valve is doing what?
6. Which valve is doing what?
7. This is measuring aortic…

Aortic, Ventricular, and Atrial Pressure
Extra Questions

• Does heart rate increase or decrease when initially holding your breath?
  It decreases due to mammalian diving reflex

• As a result does time 1 or time 2 change? Does it become longer or shorter?
  Time 2 changes, which is the time between ventricular relaxation and atrial contraction

• After strenuous activity, does time 1 or 2 change? Does it become longer or shorter?
  Time 2 changes
Arteries
Veins
Hepatic Portal System
Arteries: Circle of Willis
Coronary Circulation: Arteries and Veins
Arteries of the Celiac Trunk

(a) Branches of the celiac trunk
Superior and Inferior Mesenteric Arteries
1. Right common Iliac
2. Right internal Iliac
3. Right external iliac
4. Femoral
5. Popliteal
6. Dorsalis Pedis

Blood Vessels of the Legs
Hepatic Portal System

Portal System: two capillary beds
Deoxygenated blood returns to the heart via the superior vena cava, inferior vena cava, and the coronary sinus.
Tracing Blood (Circle of Willis to Big Toe)
The 4 nm intercellular cleft allows solutes like glucose to pass through. 

Molecules such as small proteins but still retain RBC and platelets can pass through the 20-100 nm filtration pours. 

Big enough to let RBC, and albumin pass is the 30-40 µm filtration pours.

Examples:
- Skeletal muscle
- Kidneys, Endocrine glands, small intestines
- Liver, spleen, Red Bone Marrow

Blood Flow

Examples
- Aorta, subclavian, common carotid, pulmonary trunk, common iliac
- Brachial, femoral, renal, splenic
- To various organs

Conducting Arteries to Post Capillary Venules via Etchers, Distributing Arteries, Resistance Arteries, Arterioles, Metarterioles, Capillaries.
In general, you will see the following properties throughout arteries and veins. The specific qualities of the tunica media will be based on the location of the blood vessel and the pressure of the blood.

- **Elastic Fibers**
  - *Seen in areas of high blood pressure (aorta, pulmonary trunk, common carotid, subclavian) and used to absorb/lessen blood pressure for the downstream arteries*

- **Collagen**
  - *Specifically in places of high blood pressure*

- **Smooth muscle**
  - *Seen in areas where you need to decrease blood pressure: distributing arteries which control blood flow to large areas of your body (femoral/brachial) and specific organs (splenic and renal)*
  - *Also seen in resistance arteries which control blood to specific organs (resistance arteries)*
Questions

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The Academic Support Center @ Daytona State College
http://www.daytonastate.edu/asc/ascscehandouts.html