Collin College

BIOL 2402
Anatomy/Physiology 2

Chapter 18
The Endocrine System

Pituitary Gland or Hypophysis

The Pituitary Gland

- Also called hypophysis
- Lies within sella turcica
- Hangs inferior to hypothalamus and between optic chiasma and mamillary bodies
- Connected to the hypothalamus by infundibulum
Pituitary Gland has a two part embryological origin

- One part develops from floor of the diencephalon
- Other part comes from the roof of the stomodeum

The stomodeum, a depression between the brain and pericardium and is the precursor to mouth and anterior lobe of the Pituitary Gland.

(image: 3 week embryo (Gray's Anatomy)

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Around 4th week, an epithelial pouch grows upwards from the stomodeum towards the developing brain (= Rathke’s Pouch), where it meets up with a down growth (= Infundibulum) from the brain region.

(Figure 5.2. a Developmental anatomy of the pituitary.)
Around 6th week, the connection between Rathke’s pouch (RP) and stomodeum become degenerated (see C)
Cells of RP proliferate to form the Pars distalis, and upwards the infundibulum to form the Pars tuberalis, while the infundibulum expands inferiorly.

Pituitary Gland or Hypophysis

In later stages, the sphenoid bone isolates the pituitary gland from the roof region, protecting it within the sella tursica.

Figure 5.2.b Developmental anatomy of the pituitary.
The adult form is thus made from a posterior lobe and an anterior lobe (containing Pars tuberalis, Pars distalis and Pars intermedia)

**ANTERIOR LOBE**

- Anterior lobe of the PG is also called the **adeno-hypophysis (or anterior pituitary gland)**
  - Has 3 distinct regions
    - **Pars distalis**
    - **Pars tuberalis**
    - **Pars intermedia**
  - It is derived from epithelial tissue, differentiated into several groups with important glandular functions.
  - There is no neural connection with the HT
Anterior pituitary gland

- 6 distinct hormones are produced in the adenohypophysis

- The secretion of these hormones is controlled by specific releasing and inhibiting hormones produced in the Hypothalamus (tropic hormones)

- This requires an intricate network of blood vessels and capillaries to direct the hypothalamic hormones to APG cells

Hypophyseal Portal System

There are thus two capillary beds connected via portal vessels!

This system is called the hypophyseal portal system and is fed by the superior hypophyseal artery.
Posterior pituitary gland or PPG

- Contains mostly nerves
- The cell bodies of the nerves are located in the hypothalamus
- Axons extend into the PPG
- Hormones are directed to the axon terminals and secreted by nerve stimuli. Thus, other names for the PPG are
  - Pars Nervosa
  - Neuro-hypophysis
- an inferior hypophyseal artery and vein supply and drain the posterior lobe

Hormones of the posterior pituitary gland

Only two hormones are released by the PPG

- Oxytocin
- Anti-diuretic Hormone (ADH)

The hormones are produced by neuronal cell bodies, located in the Hypothalamus and directed via neurons of the hypothalamic-hypophysial tract to the capillary bed of the PPG.

(why is it called a tract?)
Hormones of the posterior pituitary gland

Those neuronal cell bodies in the HT are:

- **Supraoptic nuclei**
  - these produce ADH

- **Paraventricular nuclei**
  - these produce Oxytocin

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**AntiDiuretic Hormone or ADH (Vasopressin)**

- Physiological effect is to decrease the urine output and urine production

- ADH causes the kidneys to remove water from the urine that is being formed in the nephrons of the kidneys and re-direct it into the bloodstream.

- Since ADH promotes water return to the blood, it regulates **blood volume** and the **state of dehydration** of our body

- ADH production is thus of homeostatic importance and regulation is by means of negative feedback
Hypothalamic nuclei have osmo-receptors that detect changes in blood osmolarity

Increased state of Dehydration means less fluid and results in increased "particles" per volume unit = osmolarity

This increased blood osmolarity is sensed by the osmo-receptors in hypothalamus and results in the release of ADH from the PPG into the blood

ADH travels via the blood stream to the target organ (the kidney), where it promotes water retention.

less urine production
**Feedback Regulation of Kidneys**

Release of ADH is directly correlated to the degree of dehydration (blood osmolarity)

- Normal blood osmolarity = 285 mOsm
- Above that = indicates dehydration

**Factors that release ADH**

- Dehydration
  - Excessive sweating
  - Not enough water intake
  - Diarrhea
- Low blood pressure
  - Blood loss

**Factors that inhibit ADH release**

- Osmolarity below 280 Osm
  - Over-hydration
- Alcohol
  - Inhibits ADH secretion
Diabetes insipidus

- Results from hypo-secretion of ADH or hypo-responsiveness
  - damage to PPG or nonfunctional ADH receptors
- Symptoms: excretion of large amounts of urine, dehydration, thirst
- Normal urine volume ~ 1 to 1.5 L / day
- With no ADH present: urine volume ~ 24 L / day

Oxytocin

Major function in the female, less important in the male

- Enhances smooth muscle contraction in the uterus during labor
- It is one of the few positive feedback mechanisms
  - stretching of cervix during delivery stimulates stretch receptors in the uterine wall
  - receptors signal HT to release more oxytocin
  - results in more contractions and movement of baby through the birth canal, additional stretching
  - Additional “help” is provided by release of local prostaglandins.
Oxytocin

Oxytocin also Enhances milk ejection by stimulation of smooth muscle in lacteal ducts of the mammary glands after childbirth.

ProLactin, an APG hormone, is responsible for milk production and secretion. (see later)
Oxytocin makes you wanna cuddle

Research links oxytocin with socio-sexual behaviors

The Hormone Involved In Reproduction May Have a Role In The Maintenance Of Relationships !

Oxytocin negates fear, induces trust ?

The scans of oxytocin’s effects on the human brain reveal that it quells the brain’s fear hub, the amygdala (and its associated brainstem relay stations), in response to fearful stimuli.

Research seems to indicate that oxytocin negates fear and increases trust in humans
The many roles of oxytocin

ADH and Oxytocin are Peptide Hormones

**Oxytocin**

Cys - Tyr - Ile - Gln - Asn - Cys - Pro - Leu - Gly - NH₂

S-S

**ADH (vasopressin)**

Cys - Tyr - Phe - Gln - Asn - Cys - Pro - Arg - Gly - NH₂

S-S

Knowing this, can they enter cells? How would they work at cell level?
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