

The Endocrine Physiology

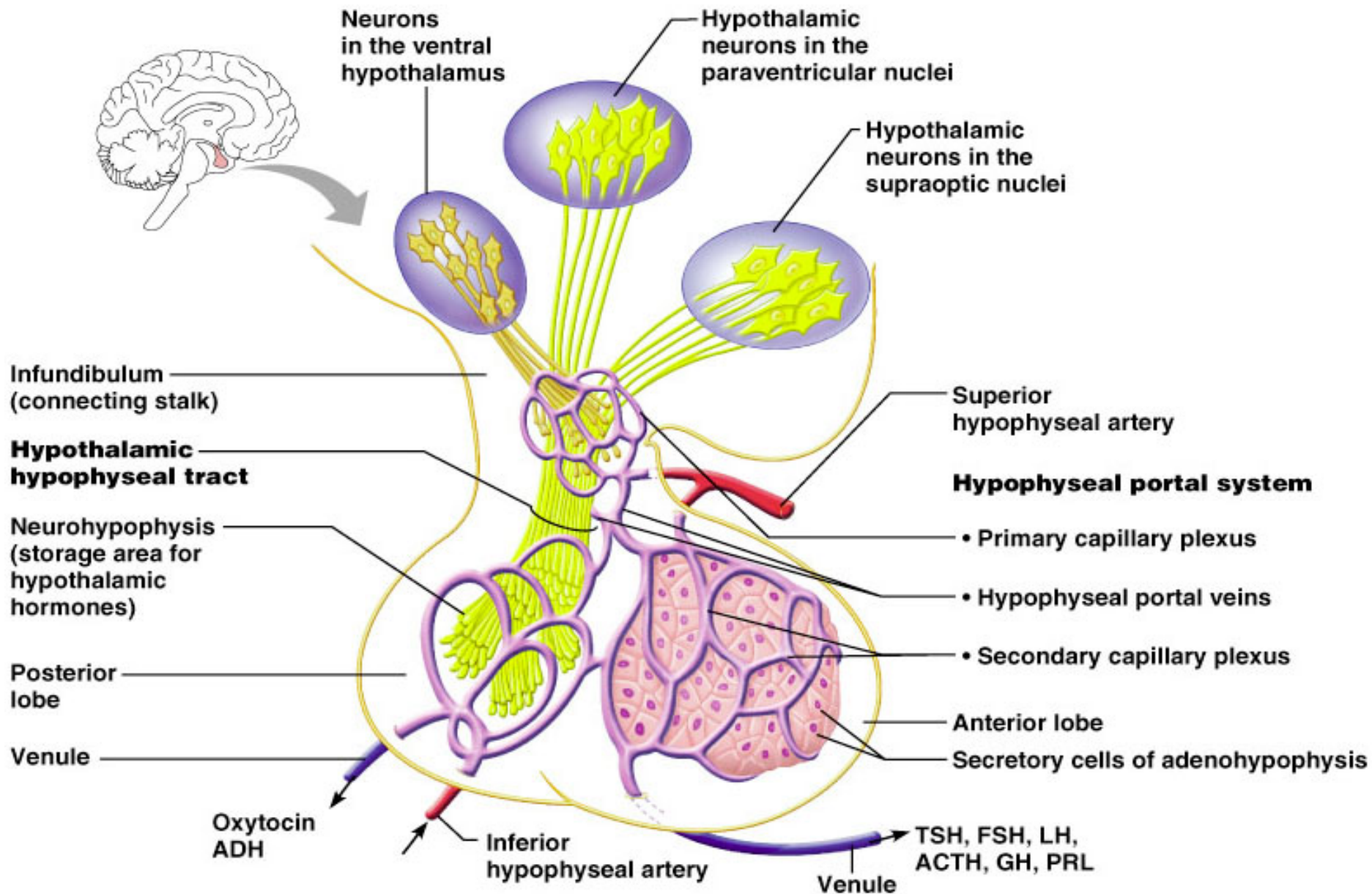
Posterior Pituitary

Dr. Khalid Alregaiey

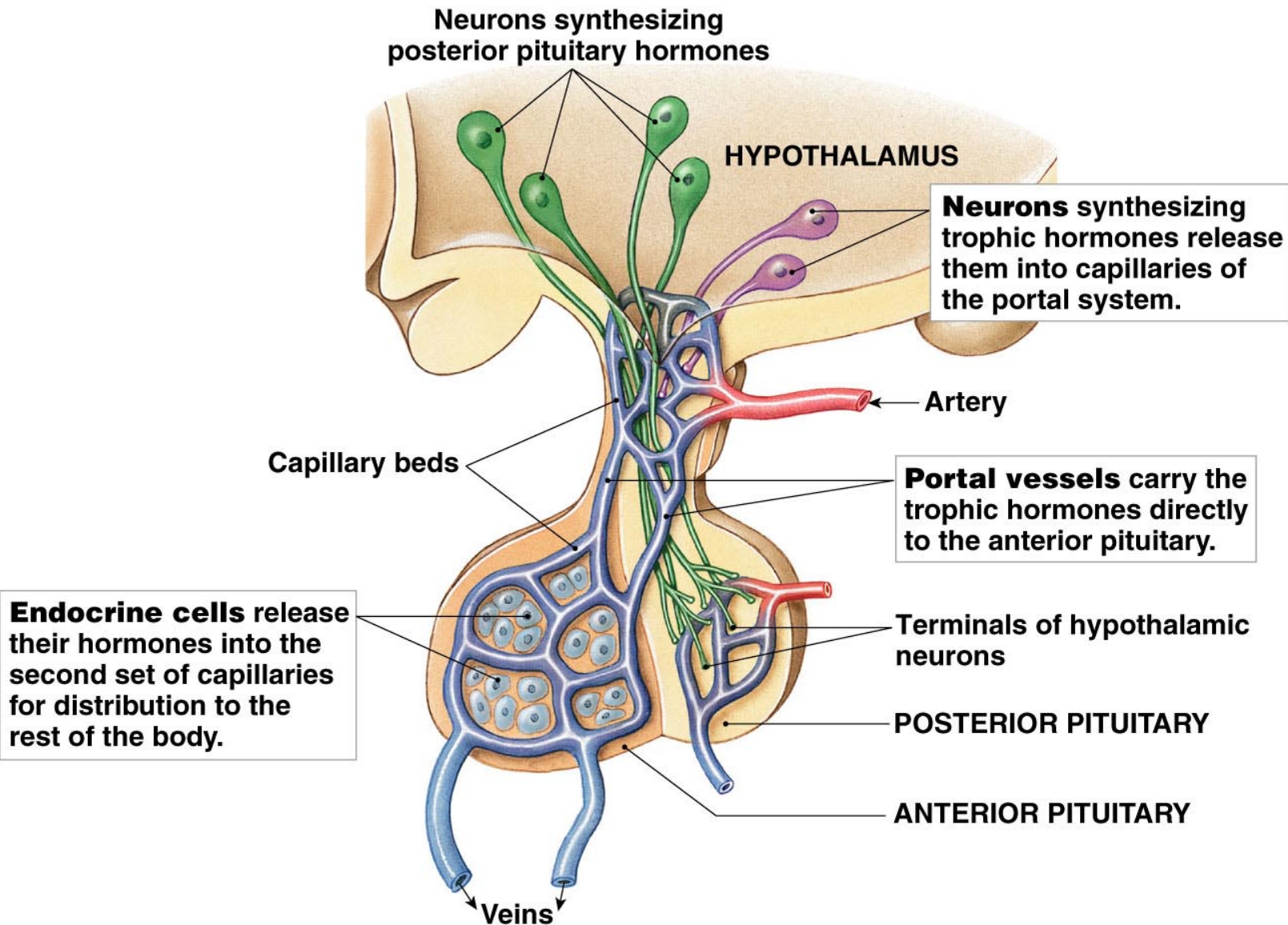
Learning Objectives

- Describe the posterior pituitary relationship with the hypothalamus
- List the target organs and functional effects of oxytocin.
- Name the stimuli for oxytocin release in relation to its reproductive and lactation functions.
- List the target cells for ADH and explain why ADH is also known as vasopressin.
- Describe the stimuli and mechanisms that control ADH secretion.
- Identify disease states caused by a) over-secretion, and b) under-secretion of ADH and list the principle symptoms of each.

Pituitary (Hypophysis)



Pituitary (Hypophysis)



The Posterior Pituitary and Hypothalamic Hormones

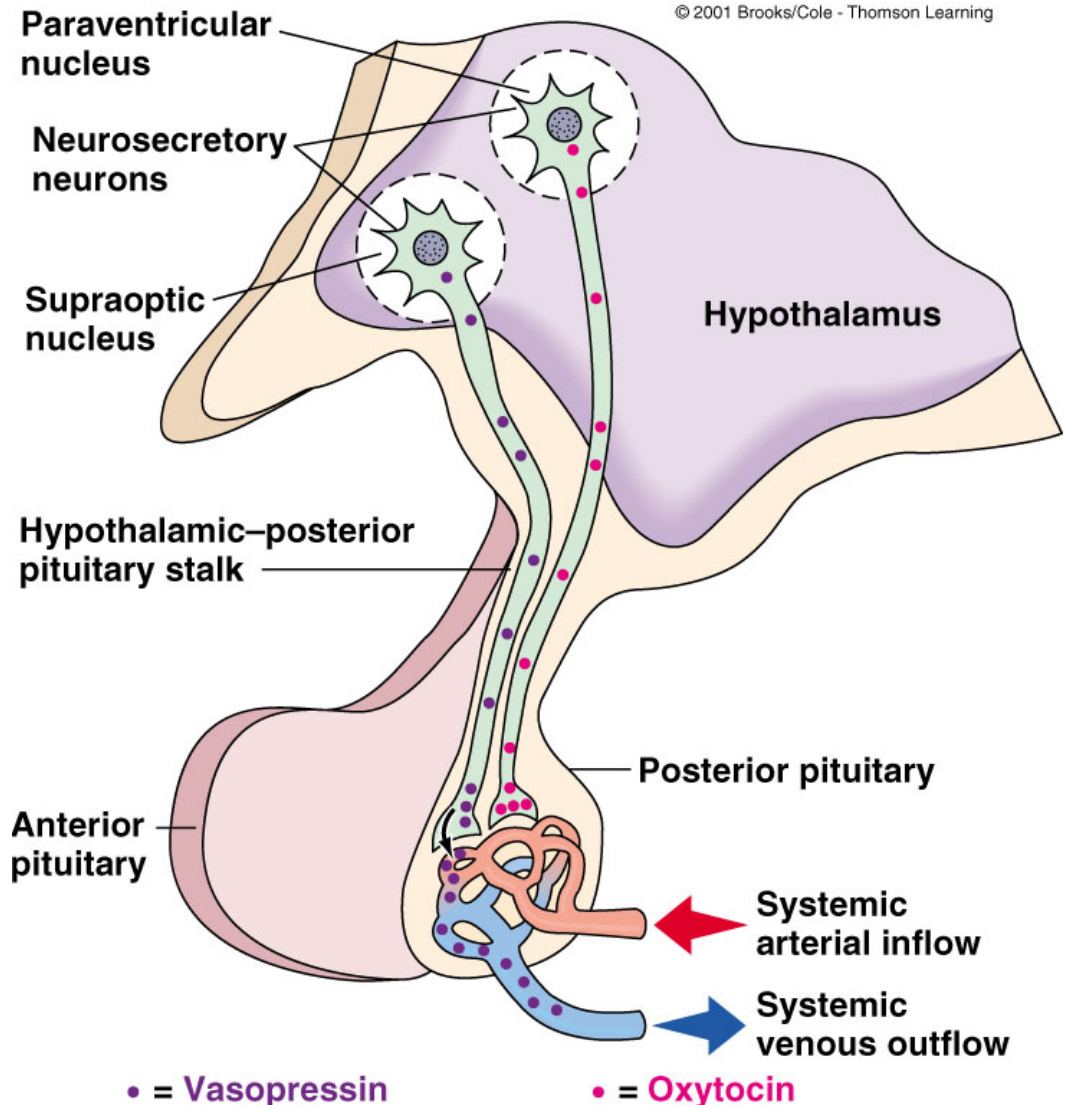
- The *posterior pituitary gland* is composed mainly of glial-like cells called *pituicytes*.
- Has a neural connection with the hypothalamus (*hypothalamic-hypophyseal tract*)
- Nuclei of the hypothalamus synthesize oxytocin and antidiuretic hormone (ADH)
- Their axons pass through the *pituitary stalk* to the neurohypophysis and terminate in the posterior pituitary.

Oxytocin and Vasopressin

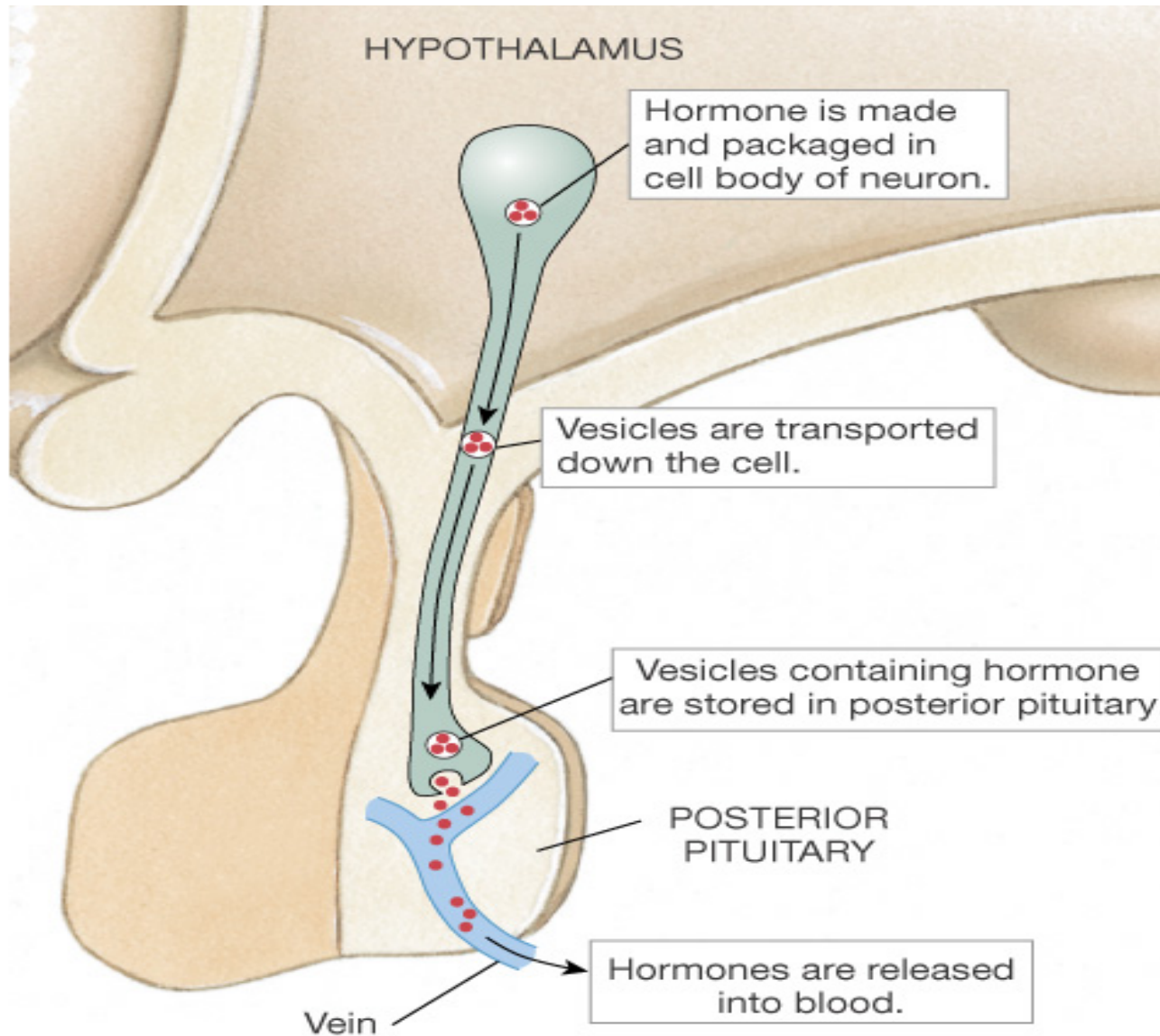
- **Vasopressin:** Cys-Tyr-Phe-Gln-Asn-Cys-Pro-Arg-GlyNH₂
- **Oxytocin:** Cys-Tyr-Ile-Gln-Asn-Cys-Pro-Leu-GlyNH₂

Posterior pituitary

- Does not synthesize hormones
- Consists of axon terminals of hypothalamic neurons



Secretion of Posterior Pituitary Hormones



Oxytocin



Synthesis of Oxytocin

- Oxytocin is synthesized in the cell bodies of hypothalamic neurons (paraventricular nucleus)
- Oxytocin is stored in the posterior pituitary

Functions of oxytocin

- Oxytocin is a strong stimulant of uterine contraction
- Regulated by a positive feedback mechanism
- This leads to increased intensity of uterine contractions, ending in birth
- Oxytocin triggers milk ejection (“letdown” reflex)
Contracts the *myoepithelial cells* of the alveoli
- Increases contraction of smooth muscle of the vas deferens, helping in the ejaculation process.

Antidiuretic Hormone (ADH)

(vasopressin)

Synthesis of ADH

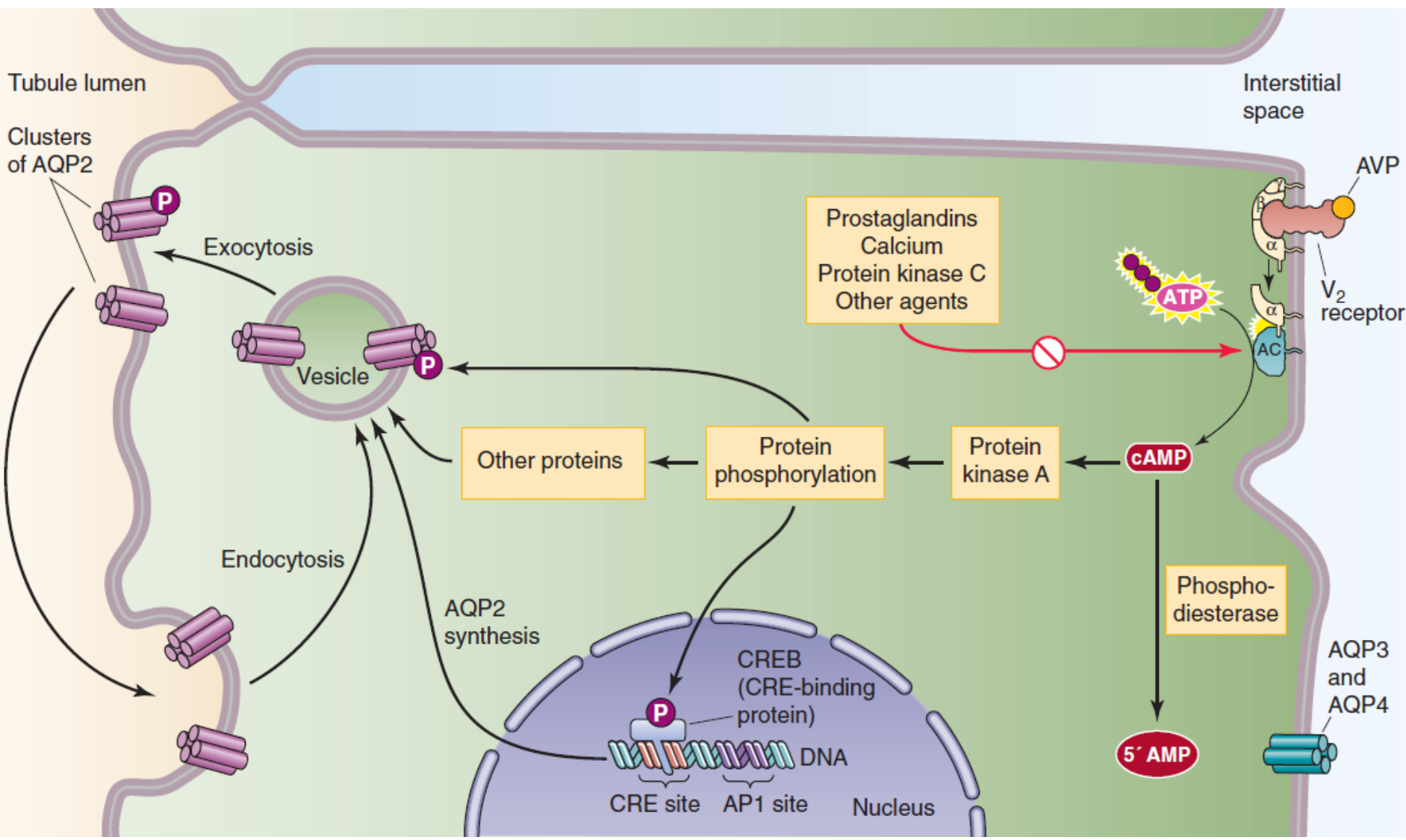
- It is synthesized as pre-prohormone and processed into a nonapeptide (9 amino acids)
- ADH synthesized in the cell bodies of hypothalamic neurons(**supraoptic nucleus**)
- ADH is stored in the posterior pituitary

Receptors of ADH (vasopressin)

- There are 2 types of receptors for ADH:
 - V_1
 - V_2
- ⊙ **V_1** receptors mediate vasoconstriction
- ⊙ **V_2** receptors are located in the *principle cells* in distal convoluted tubule and collecting ducts in the kidneys

- in the absence of ADH, the collecting tubules and ducts become almost impermeable to water
- Which allows extreme loss of water into the urine
- When ADH binds to its receptor, it activates the translocation of vesicles containing aquaporins to the apical cell membranes

Mechanism of action of ADH



Control of ADH Release

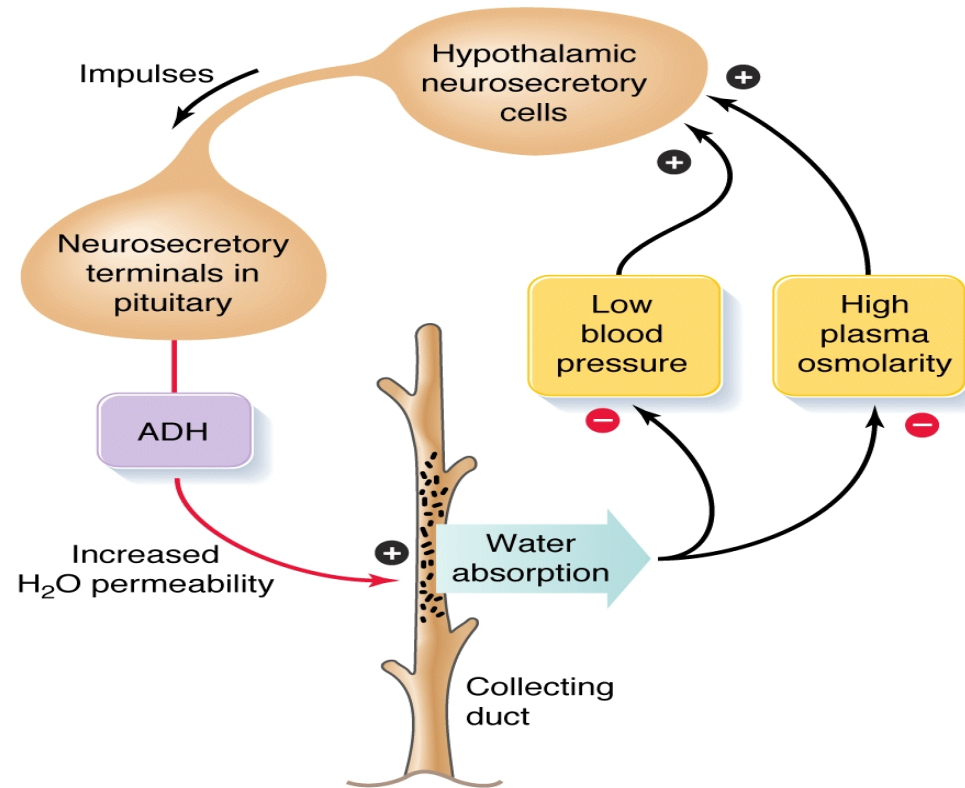
- 1. Increased Extracellular Fluid Osmolarity Stimulates ADH Secretion:**
 - Osmoreceptors in or near the hypothalamus:
 - \uparrow osmotic pressure \rightarrow \uparrow ADH secretion
 - \downarrow osmotic pressure \rightarrow \downarrow ADH secretion
- 2. Low Blood Volume and Low Blood Pressure Stimulate ADH Secretion—Vasoconstrictor Effects of ADH:**
 - **Baroreceptor** in carotid artery and aortic arch, and left atrium:
 - \uparrow blood pressure \rightarrow \downarrow ADH secretion
 - \downarrow blood pressure \rightarrow \uparrow ADH secretion
- 3. Physiological stress: pain, fear, trauma, and stress stimulate ADH release.**

Regulation of ADH

Hypothalamus receives feedback from:

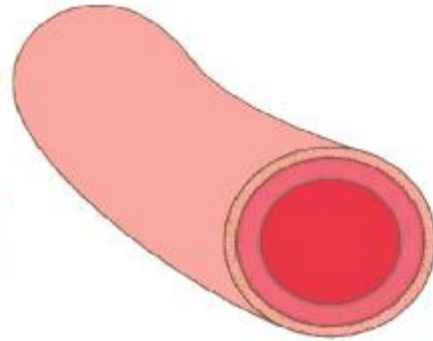
- Osmoreceptors
- Aortic arch baroreceptors
- Carotid baroreceptors
- Atrial stretch receptors

Any increase in osmolality or decrease in blood volume will stimulate ADH secretion from posterior pituitary.



Effects on Blood Vessels

Normal



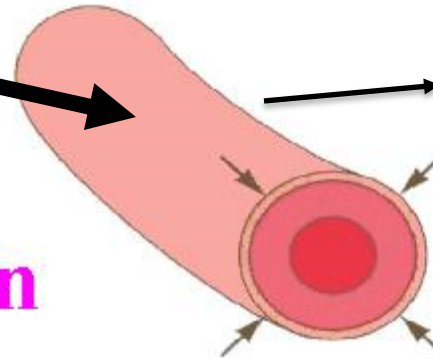
ADH

V1 receptor

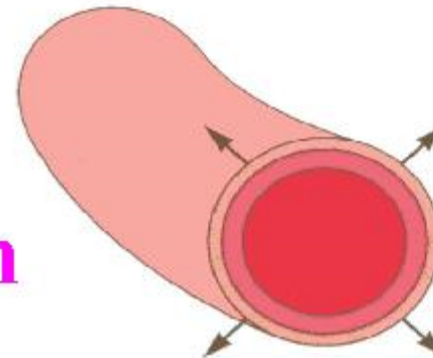


***Increased
Blood
Pressure***

Vasoconstriction



Vasodilation



ADH Disorders

- **Diabetes Insipidus:**

Neurogenic (central): (failure of hypothalamus or neurohypophysis to synthesize or secrete ADH)

Nephrogenic: (failure of the kidney to respond appropriately to ADH)

- Syndrome of Inappropriate Antidiuretic Hormone (**SIADH**)

DIABETES INSIPIDUS

- DI is a disorder resulting from deficiency of anti-diuretic hormone (ADH) or its action and is characterized by the passage of copious amounts of dilute urine.
- It must be differentiated from other polyuric states such as primary polydipsia & osmotic diuresis. Central DI is due to failure of producing adequate ADH.

DIABETES INSIPIDUS

- Nephrogenic DI results when the renal tubules of the kidneys fail to respond to circulating ADH.
- The resulting renal concentration defect leads to the loss of large volumes of dilute urine. This causes cellular and extracellular dehydration and hypernatremia.

Treatment

- DESMOPRESSIN (DDAVP) A SYNTHETIC ANALOG IS SUPERIOR TO NATIVE AVP BECAUSE:
- IT HAS LONGER DURATION OF ACTION (8-10 h vs 2-3 h)
- MORE POTENT, ITS ANTIDIURETIC ACTIVITY IS 3000 TIMES GREATER THAN ITS PRESSOR ACTIVITY

Treatment of Nephrogenic DI

- CORRECTION OF UNDERLYING CAUSE
- PROVISION OF ADEQUATE FLUIDS & CALORIE
- LOW SODIUM DIET
- DIURETICS
- HIGH DOSE OF DDAVP

Summary of posterior pituitary hormones actions

