Endocrinology

Posterior Pituitary

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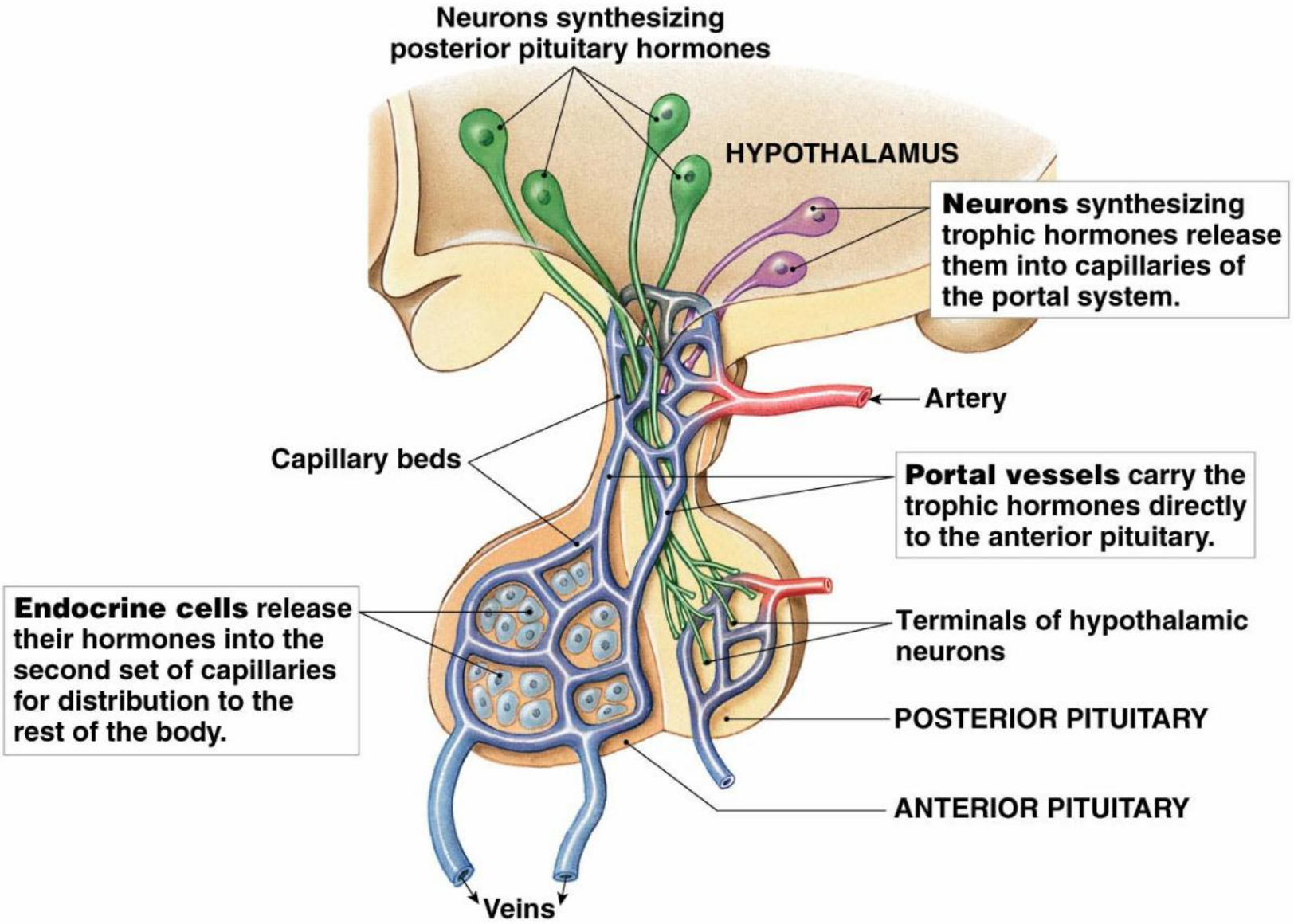
Learning Objectives

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

Pituitary (Hypophysis)



The Posterior Pituitary & Hypothalamic Hormones

- The posterior lobe is a downgrowth of hypothalamic neural tissue.
- Has a neural connection with the hypothalamus (hypothalamic-hypophyseal tract)
- Nuclei of the hypothalamus synthesize

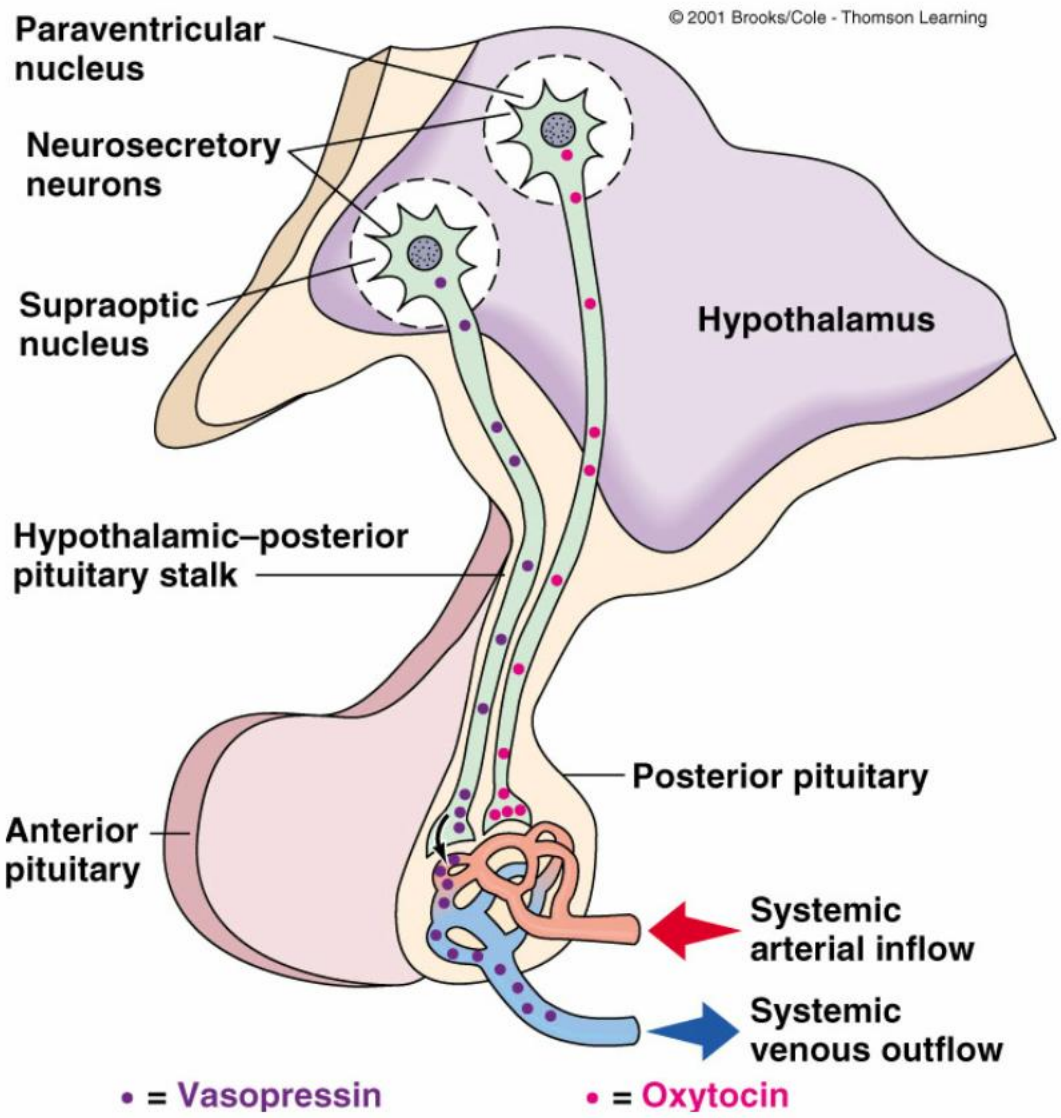
  oxytocin and antidiuretic hormone (ADH)
- Their axons terminate in the posterior pituitary.

Oxytocin and Vasopressin

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

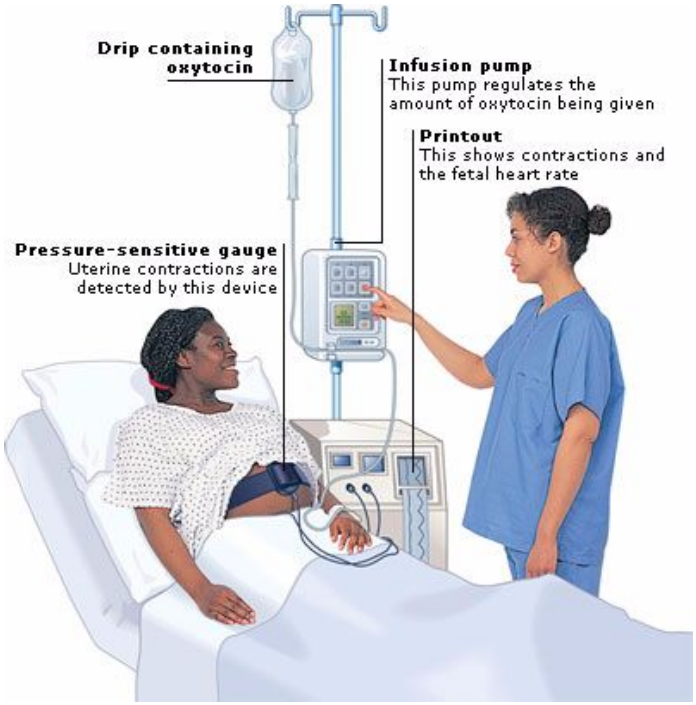
Posterior Pituitary

- Does not synthesize Hormones.
- Consists of axon terminals of hypothalamic neurons.



Oxytocin


OXYTOCIN
10 USP Units/mL
10 mL
OXYTOCIN
10 USP Units/mL


Drip containing oxytocin
Infusion pump
This pump regulates the amount of oxytocin being given
Printout
This shows contractions and the fetal heart rate
Pressure-sensitive gauge
Uterine contractions are detected by this device


Labor induction
AND
oxytocin (pitocin)

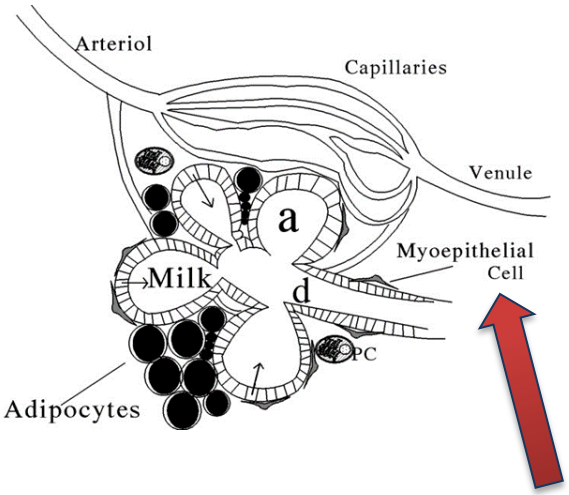
Synthesis of Oxytocin

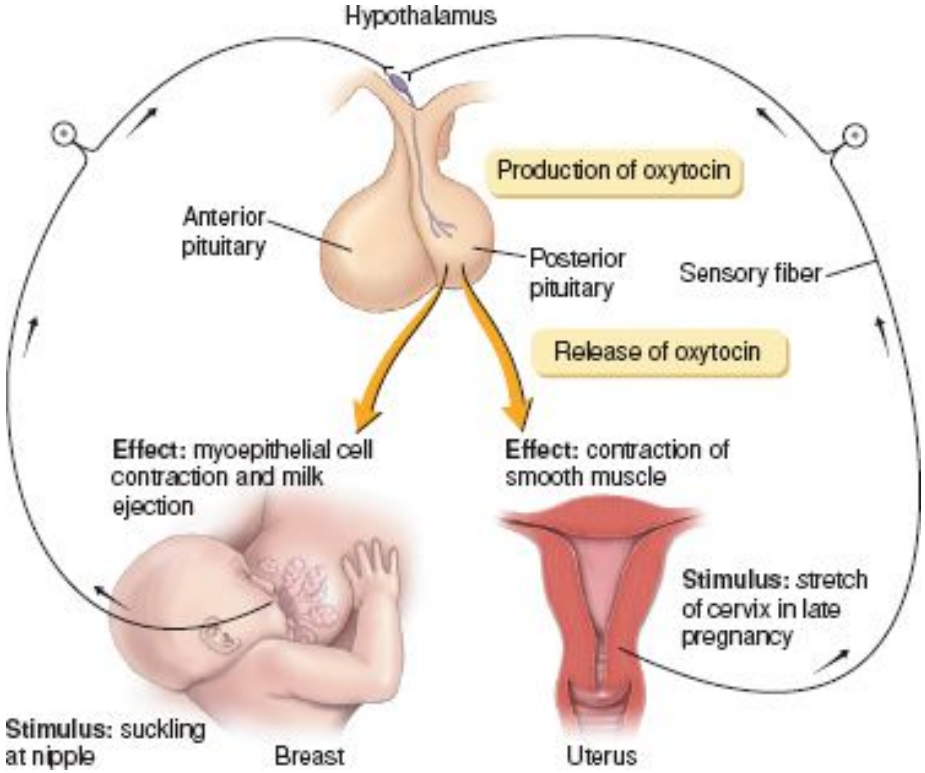
- Oxytocin is synthesized in the cell bodies of hypothalamic neurons (paraventricular nucleus)

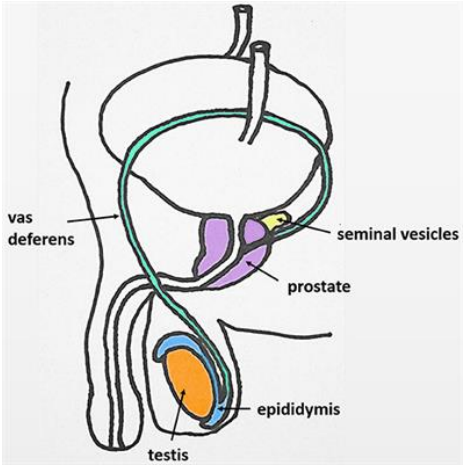
- Oxytocin is stored in the posterior pituitary

Functions of oxytocin

- Oxytocin is a strong stimulant of uterine contractions.
- 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.


Arteriol
Capillaries
Venule
a
Milk
d
Myoepithelial Cell
PC
Adipocytes


Hypothalamus
Production of oxytocin
Anterior pituitary
Posterior pituitary
Sensory fiber
Release of oxytocin
Effect: myoepithelial cell contraction and milk ejection
Effect: contraction of smooth muscle
Stimulus: stretch of cervix in late pregnancy
Stimulus: suckling at nipple
Breast
Uterus


vas deferens
seminal vesicles
prostate
epididymis
testis

Antidiuretic Hormone (ADH)

(vasopressin)

Synthesis of ADH

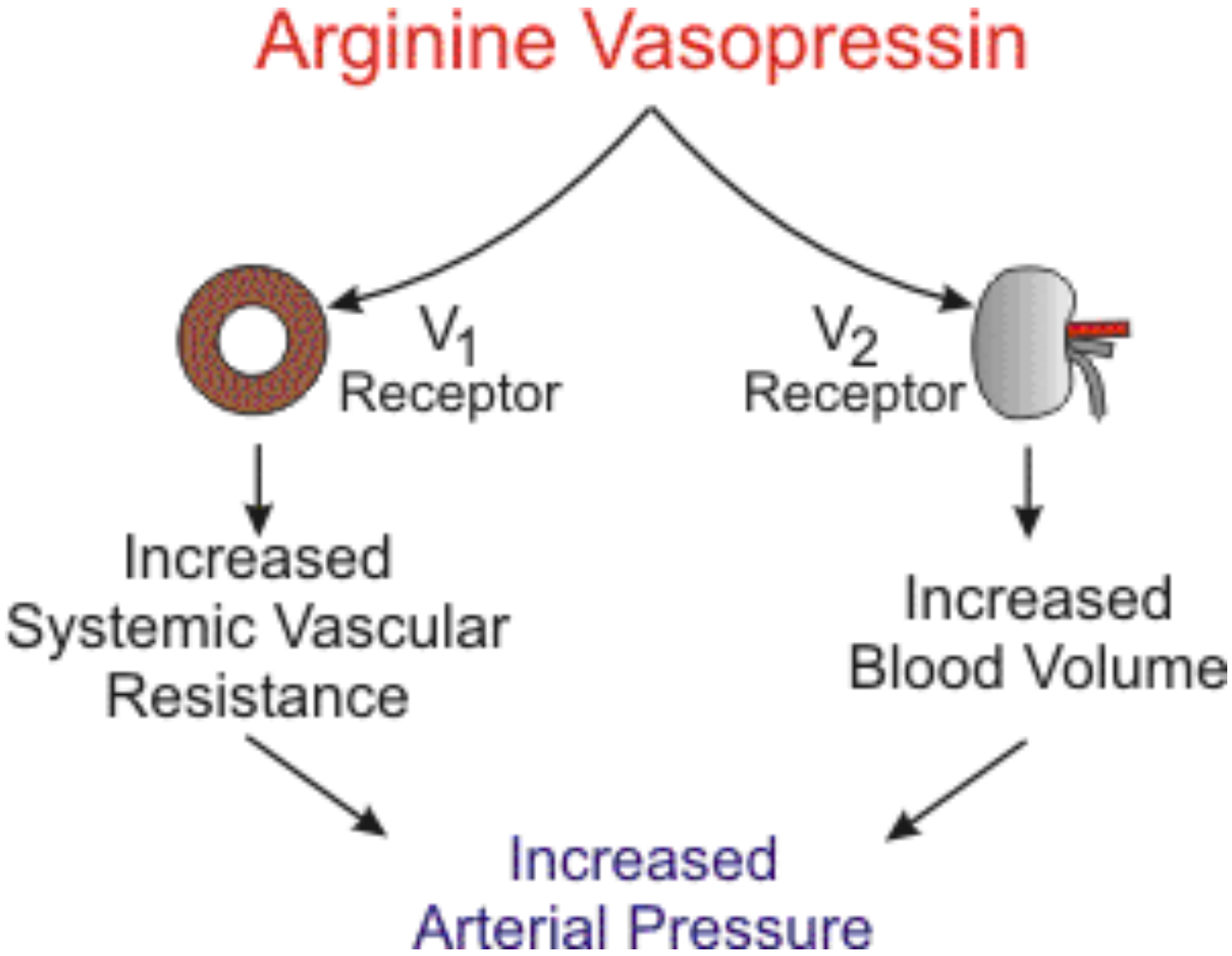
- It is synthesized as pre-prohormone and processed into a nonapeptide (9 amino acids)
- ADH synthesized in the cell bodies of hypothalamic neurons(supraoptic nucleus)
- ADH is stored in the posterior pituitary

Receptors of ADH (vasopressin)

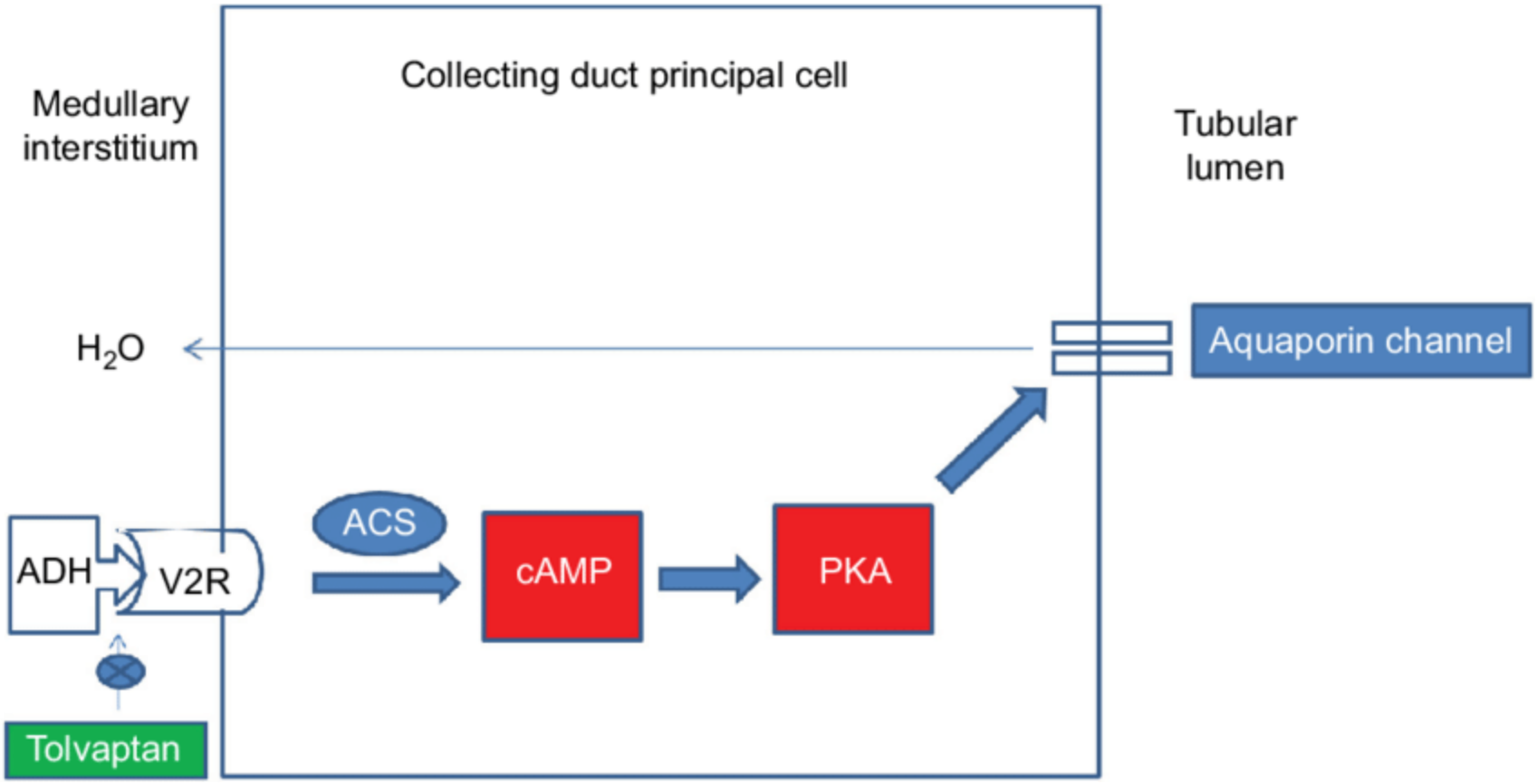
- There are 2 types of receptors for ADH:
  - V_1
  - V_2

- **V1** receptors mediate vasoconstriction.
- **V2** receptors are located in the *principle cells* in distal convoluted tubule & collecting ducts in the kidneys.

Actions of ADH



Mechanism of action of ADH



Control of ADH Release

Osmotic pressure:

Osmoreceptors in the hypothalamus:

- ↑osmotic pressure → ↑ADH secretion
- ↓ osmotic pressure → ↓ ADH secretion

Blood volume:

Baroreceptor in carotid artery, aortic arch and left atrium:

- ↑blood pressure → ↓ ADH secretion
- ↓blood pressure → ↑ ADH secretion

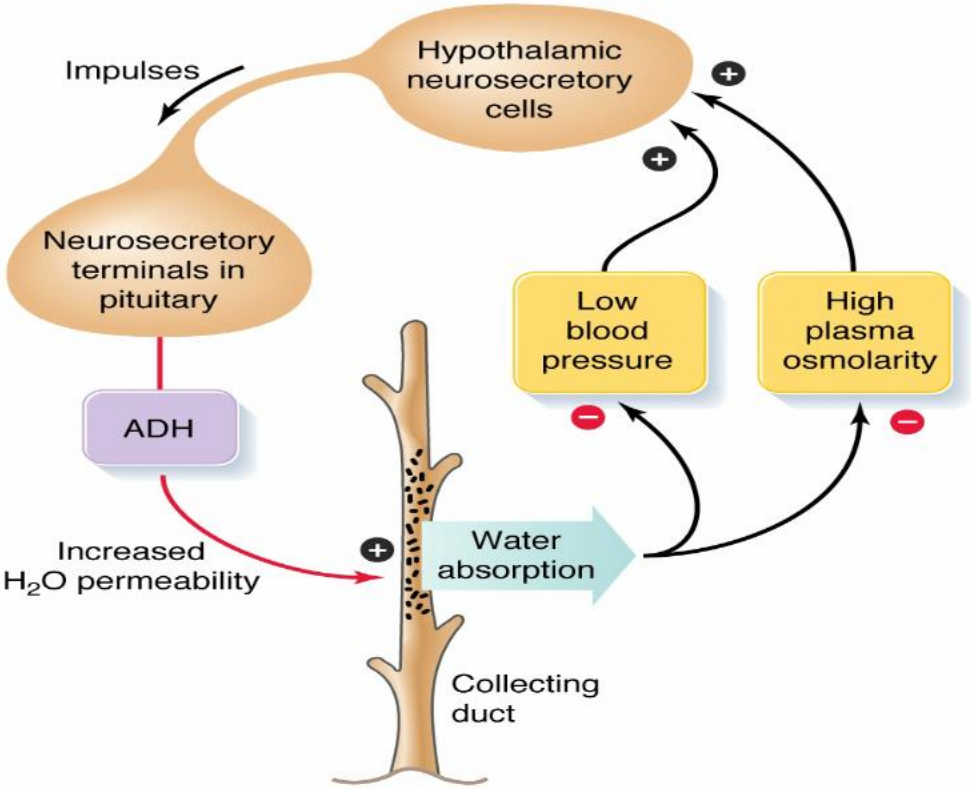
- Pain, fear, trauma, and stress

Regulation of ADH

Hypothalamus receives feedback from:

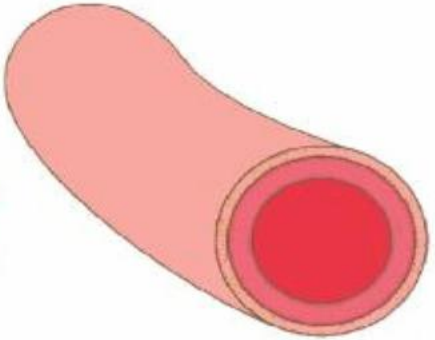
- Osmoreceptors
- Aortic arch baroreceptors
- Carotid baroreceptors
- Atrial stretch receptors

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



Effects on Blood Vessels

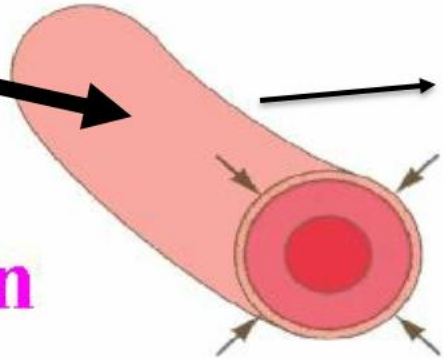
Normal



ADH

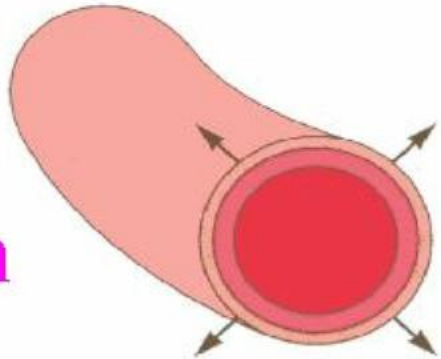
V1 receptor

Vasoconstriction



Increased Blood Pressure

Vasodilitation



ADH Disorders

- **Diabetes Insipidus (DI):**
  - **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)

DI	SIADH
• Low ADH, Low water in body • **High UO**, Polyuria • **High sodium** • High H&H and serum osmolality from dehydration • Risk: **Hypovolemic shock** • TX: DDAVP (ADH)	• High ADH, water intoxication • **Low UO**, Oliguria • **Low sodium** (dilutional) • Low serum osmolality • Weight gain • Risk: **Seizures** • TX: Hypertonic saline

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 duiresis. Central DI is due to failure of producing adequate ADH.

DIABETES INSIPIDUS

- Nephrogenic DI results when the renal tubules 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) [illegible] TIC ANALOG IS SUPE[illegible] VP BECAUSE:
- IT HAS LONGER I[illegible] ON OF ACTION (8-10 h vs 2-3 h)
- MORE POTENT
- ITS ANTIDIURET[illegible] ITY IS 3000 TIMES GREATER THAN [illegible] SSOR ACTIVITY

Treatment of Nephrogenic DI

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