The Posterior Pituitary Gland (Neurohypophysis) Hormones

Antidiuretic Hormone (ADH, Vasopressin) and Oxytocin

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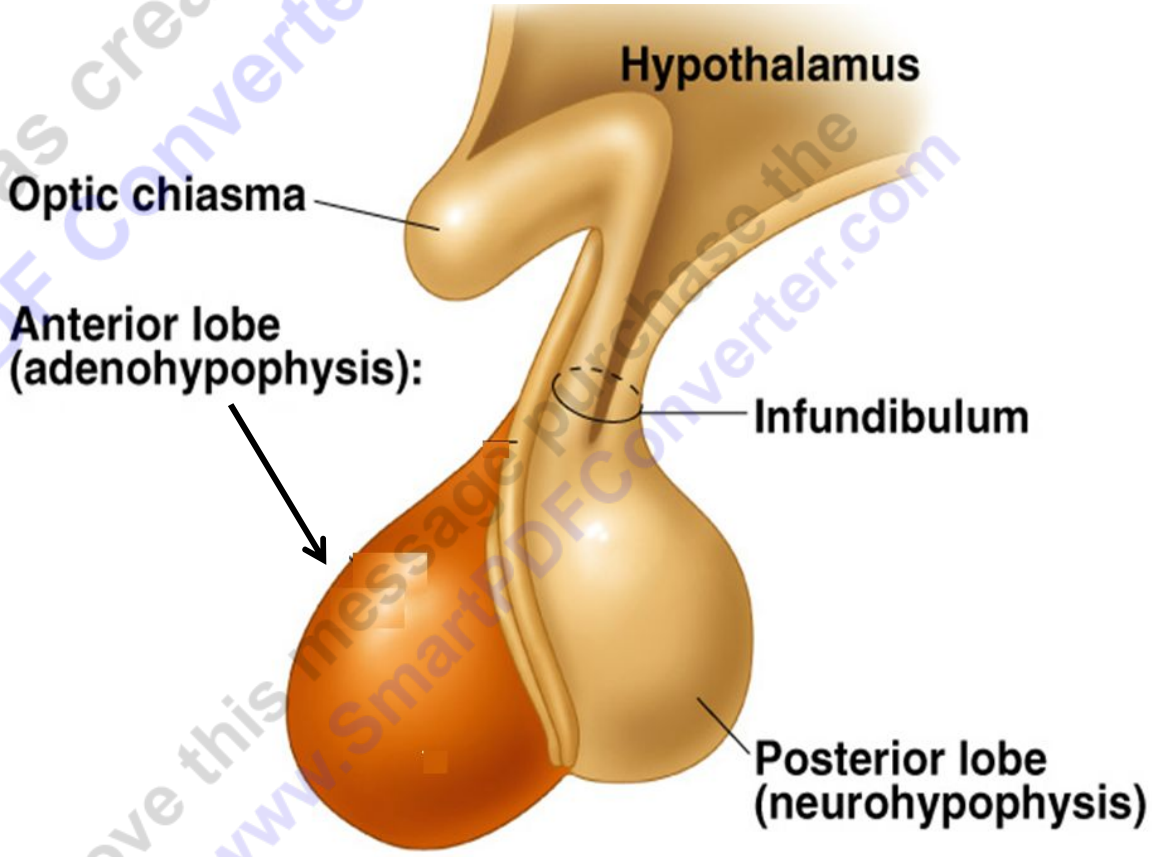
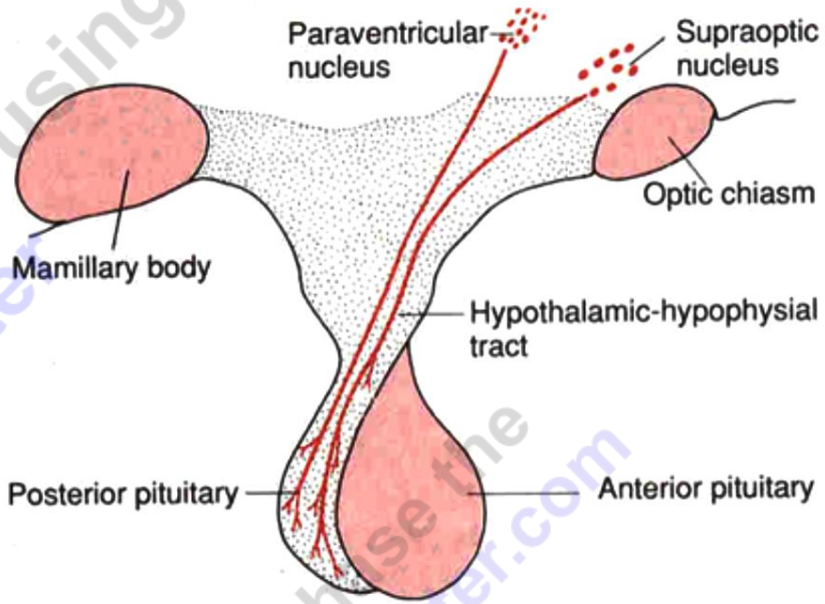
Pituitary Gland (Hypophysis)

- Pituitary gland is located in the diencephalon.
- Structurally and functionally divided into:
- (1) Anterior Lobe , also called Adenohypophysis
- (2) Posterior Lobe , also called Neurohypophysis .



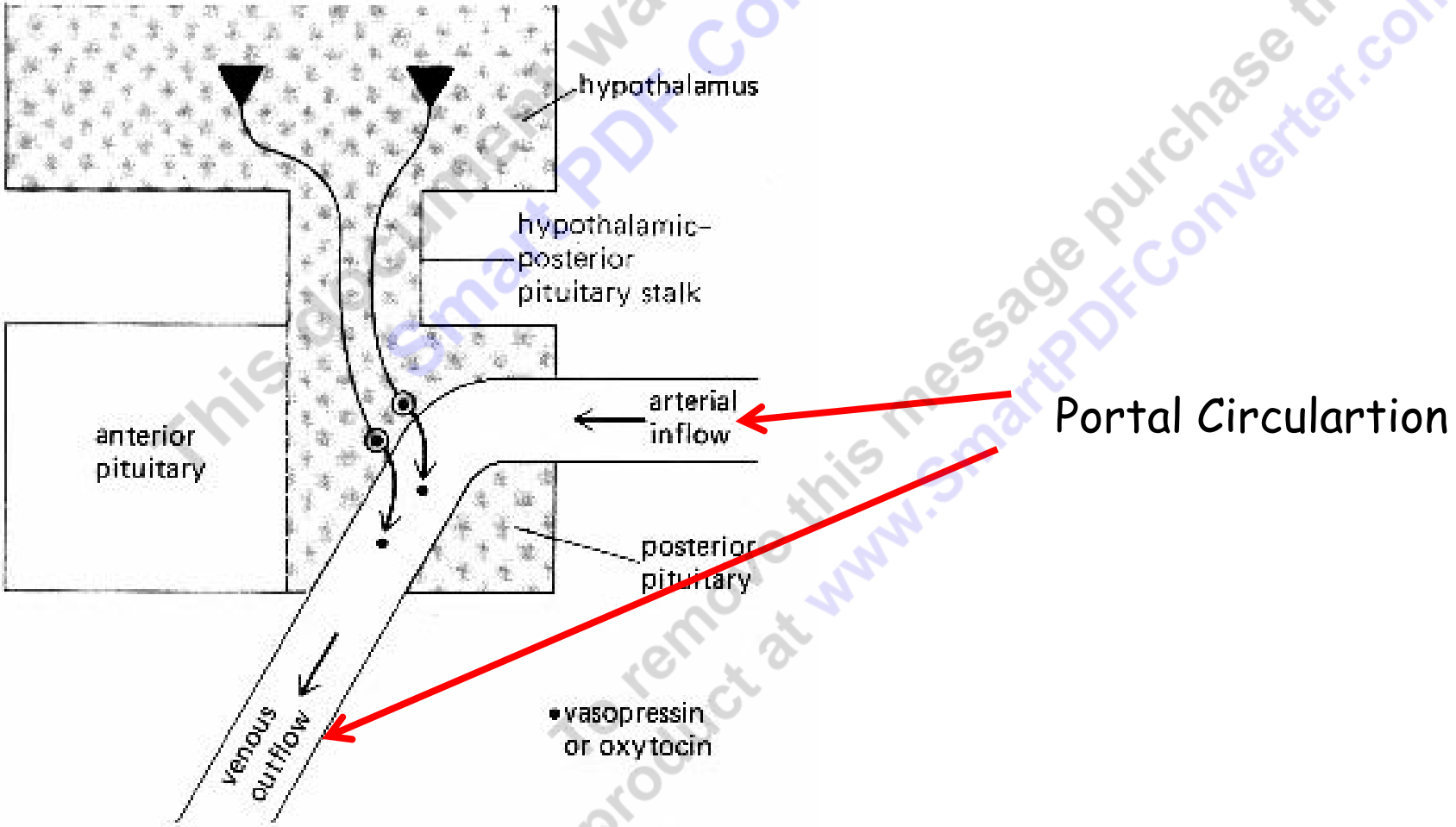
- ADH and Oxytocin are nonapeptide (nine amino acids) hormones
- They are very similar in structure , differing only in amino acids number 3 and 8 .
- They are synthesized in the in the cell bodies of hypothalamic neurons (Supraoptic and Paraventricular nuclei)
- Thereafter, they are transported to the posterior pituitary through axons of the same → and get stored in the posterior pituitary



- Action potentials in these hypothalamic axons result in the release of these hormones from the posterior pituitary.

- Structure of ADH : cys-tyr-phe-gln-asn-cys-pro-arg-gly-NH_2

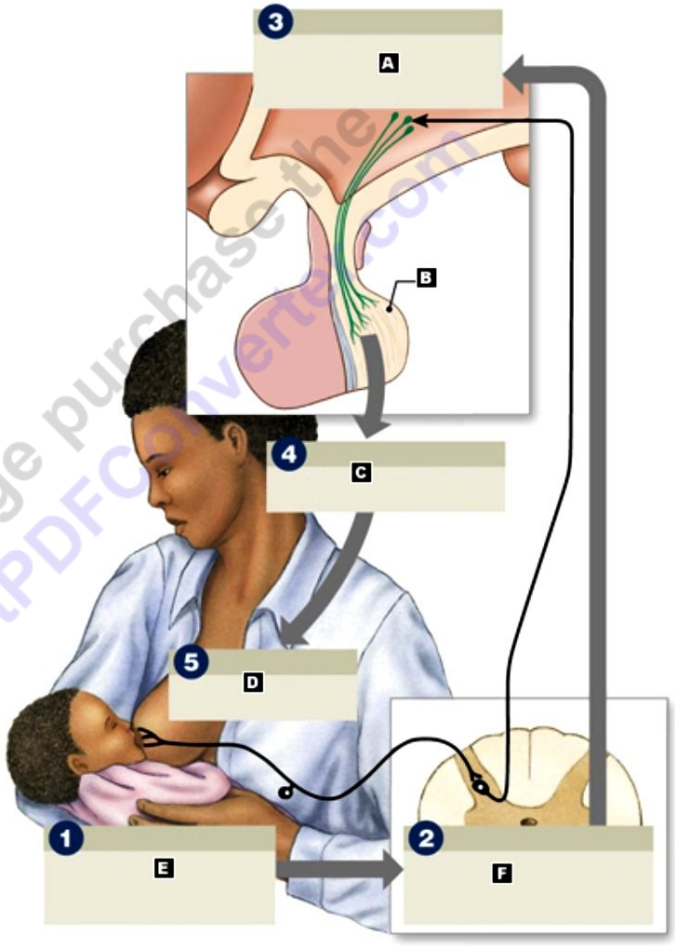
- ADH is also known as arginine vasopressin (AVP = ADH) because of its vasopressive (vasoconstrictor) activity, but its major effect is on the kidney in preventing water loss.



Physiological Actions of Oxytocin

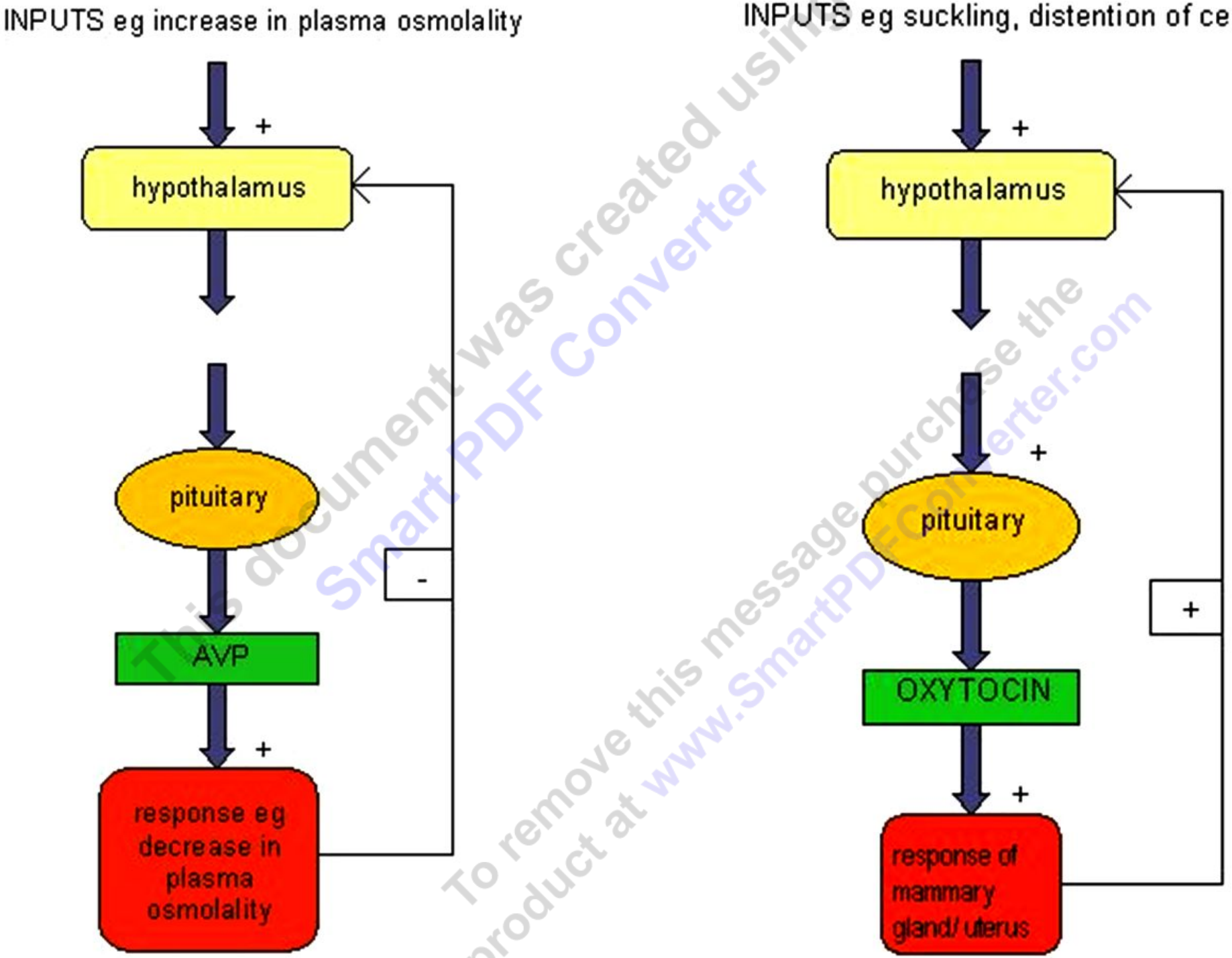
(1) Milk Ejection

- Targets the female breast of lactating women to release milk .
- Note that milk formation is by the hormone Prolactin , but milk release (when the infant suckles the mother) is by Oxytocin .
- Oxytocin release is stimulated by the infant suckling his mother's breast .
- Then oxytocin acts on myoepthelial cells (specialised contrctile smooth muscle cells thst surround milk storage cavities) → contraction → expression of milk from its site of synthesis into larger ducts of the breast → milk excretion .
- Thus, milk is then made available to a suckling infant.



Physiological Actions of Oxytocin
(2) Uterine Contraction

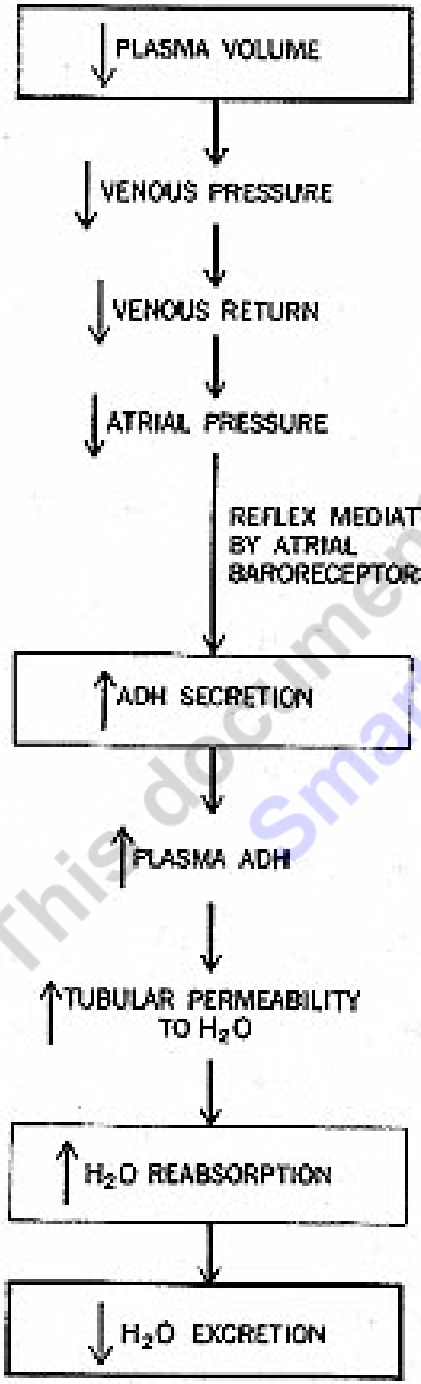
- Stimulation of mechanoreceptors in the uterine cervix and vagina during labor (parturition) cause a rise in oxytocin levels → uterine contraction .
- This helps in →
- (1) expulsion of the baby during labor
- (2) stopping bleeding after delivery
- (3) also , after the baby is born & as the mother breast-feeds him → baby suckling produces oxytocin release → milk let-down + uterine contraction (which prevents further blood-loss from the mother) .
- Oxytocic drugs (e.g., Syntocinon) are used by obtetricians ti induce labor in postmature pregnant women

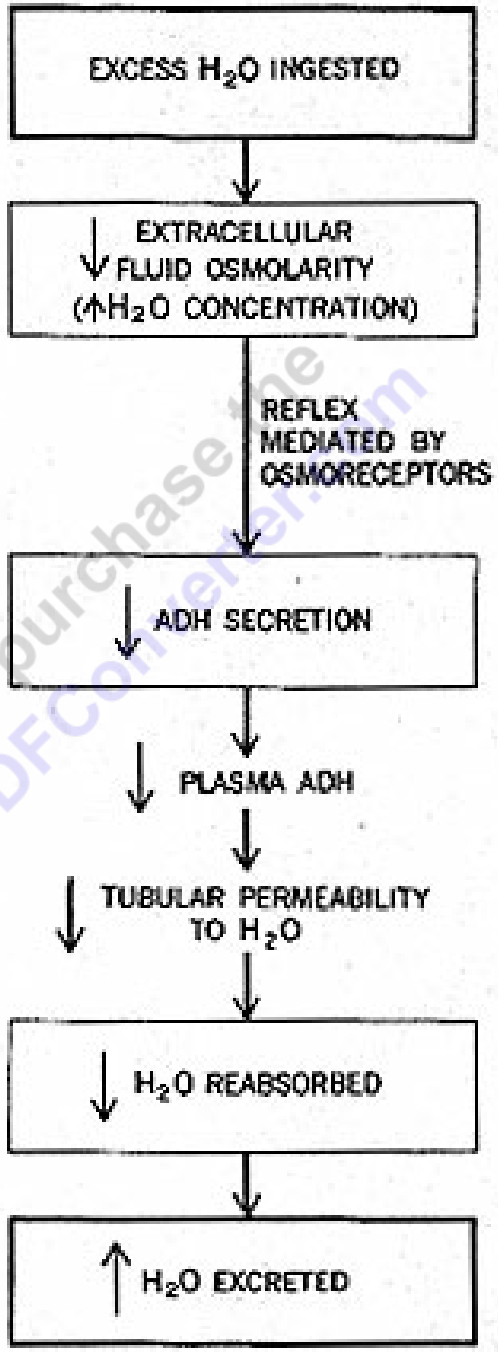


Physiological Actions of ADH

- The primary action of ADH is antidiuresis , thereby it decreases water loss by the kidney → conserves body water & regulates volume and tonicity of ECF .
- ADH secretion is regulated by osmotic and volume/ hemodynamic stimuli
- Water deprivation (or dehydration) → decreased ECF volume + ECF becomes more concentrated → ECF tonicty increased→ stimualtion of hypothalamic osmoreceptors to secrete more ADH → ADH increases kidney tubular permeabilty to water → increased water reabsorption by the kidney (thereby decreasing urine volume & decreasing water loss by the kidney) → bringing ECF volume & tonicity back to normal

- Water excess (e,g., by ingestion /drinking too much water → increased ECF volume + ECF becomes more dilute → ECF tonicty decreased → inhibition of hypothalamic osmoreceptors → decreased ADH secretion → increased water loss in urine (increased urine volume) → bringing ECF volume & tonicity back to normal .





Actions of ADH

- The major action of ADH is on renal cells that are responsible for reabsorbing free (osmotically unencumbered) water from the glomerular filtrate.
- ADH responsive cells line the distal convoluted tubules and collecting ducts of the renal medulla.
- ADH increases the permeability of these cells to water.
- The increase in membrane permeability to water permits back diffusion of water along an osmotic gradient.
- ADH action in the kidney is mediated by its binding to V2 receptors, coupled to adenylate cyclase and cAMP production.
- cAMP activates protein kinase A which prompts the insertion of water channels into the renal cell membrane → rapid water reabsorption .
- When ADH is removed, the water channels withdraw from the membrane and the apical surface of the cell becomes impermeable to water once again. .

Hemodynamic Control of ADH Secretion

- ADH secretion is stimulated by a decrease in blood volume or BP , such as occurs in dehydration or hemorrhage .
- Conversely , ADH secretion is inhibited by a rise in BP .
- A rise in BP or increase in blood volume can be detected by special types of stretch receptors that tonically inhibit the vasomotor center and tonically inhibit ADH secretion .
- These receptors are :
- (1) Baroreceptors (High Pressure receptors) situated in the carotid sinus and aortic arch
- (2) Volume Receptors (Low-Pressure receptors) located in the left atrium and pulmonary veins.
- Hypovolemia (decreased blood volume) & hypotension (decreased BP) stop/decrease the tonic inhibitory effects of these receptors , resulting in →
- (1) increasing the BP , &
- (2) increasing secretion of ADH

- The volume receptors also stimulate the sympathetic nervous system → which stimulates Renin release from Juxtaglomerular Apparatus of the kidney → this leads to activation of Angiotensin II that causes →
- (1) vasoconstriction → increase in BP
- (2) Thirst → which makes the person drink water → increase blood volume
- ,