Department of Anatomy and Histology

Pituitary Gland 2

The University of Jordan

Endocrine system

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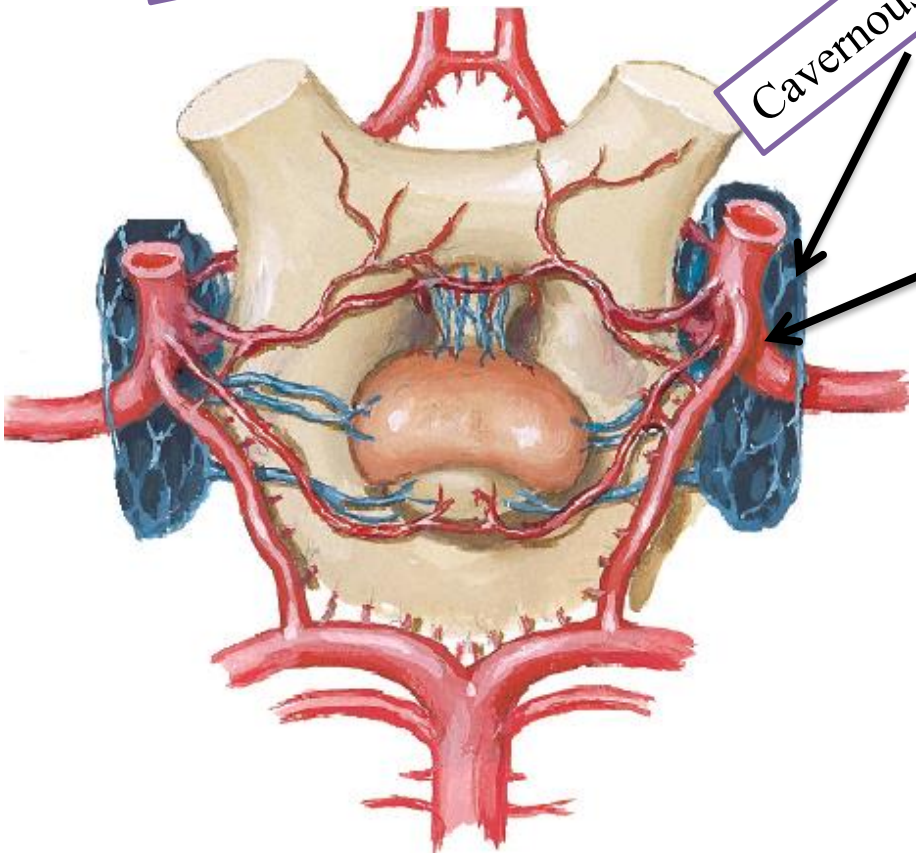
Blood supply

whenever you are asked about the blood supply of any organ, you have to think about the major arterial blood supply of it ..

for example:

abdomen=abdominal aorta
neck=external carotid
cranial cavity=internal carotid
==> so pituitary gland=internal carotid



Hypophysial arteries are branches of the intercavernous segment of The internal carotid artery

<u>The inferior</u> branch supplies the posterior lobe of the pituitary gland

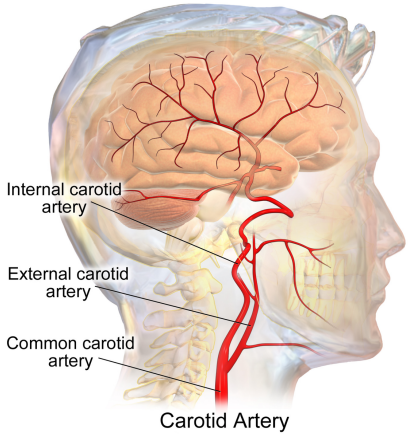
<u>The superior</u> branch leads into the median eminence to start the hypophysial portal system to the anterior lobe

the doctor said that the information below is not for memorizing.. just read it

(internal carotid artery course)

internal carotid artery is divided into many parts(segments) including:

- cervical segment
- intracranial segment
- intercavernous segment



1)origin

Right= brachiocephalic trunk

Left= arch of aorta

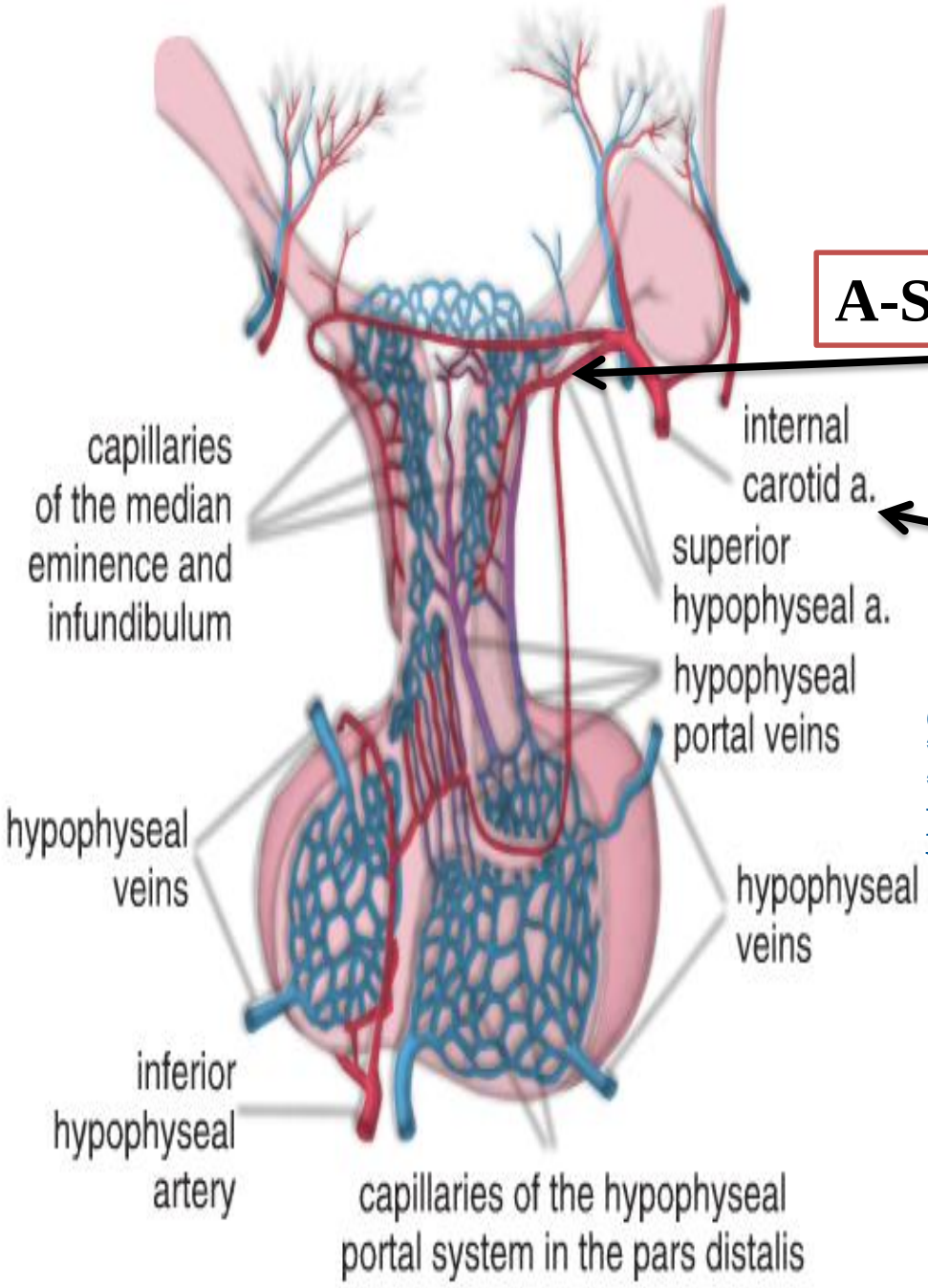
2)then the internal carotid ascends in the neck within the carotid sheath (does NOT give any branches here) cervical segment

3) next, it enters the base of the skull and pass through the carotid canal in petrous temporal bone

4) after that, it enters the cavernous sinus intercavernous segment

5) then it enters the brain and divides to the terminal cerebral arteries intracranial segment

Blood supply



A-Superior hypophyseal arteries

These vessels arise **from the internal carotid** arteries and posterior communicating artery of the circle of Willis

circle of willis:
***located at the base of the brain**
*** it is a combination of internal carotid and basilar arteries that are continuation of vertebral arteries**

They supply

The pars tuberalis
Median eminence
Infundibulum

superior hypophyseal artery

Divides into medial and lateral arteries

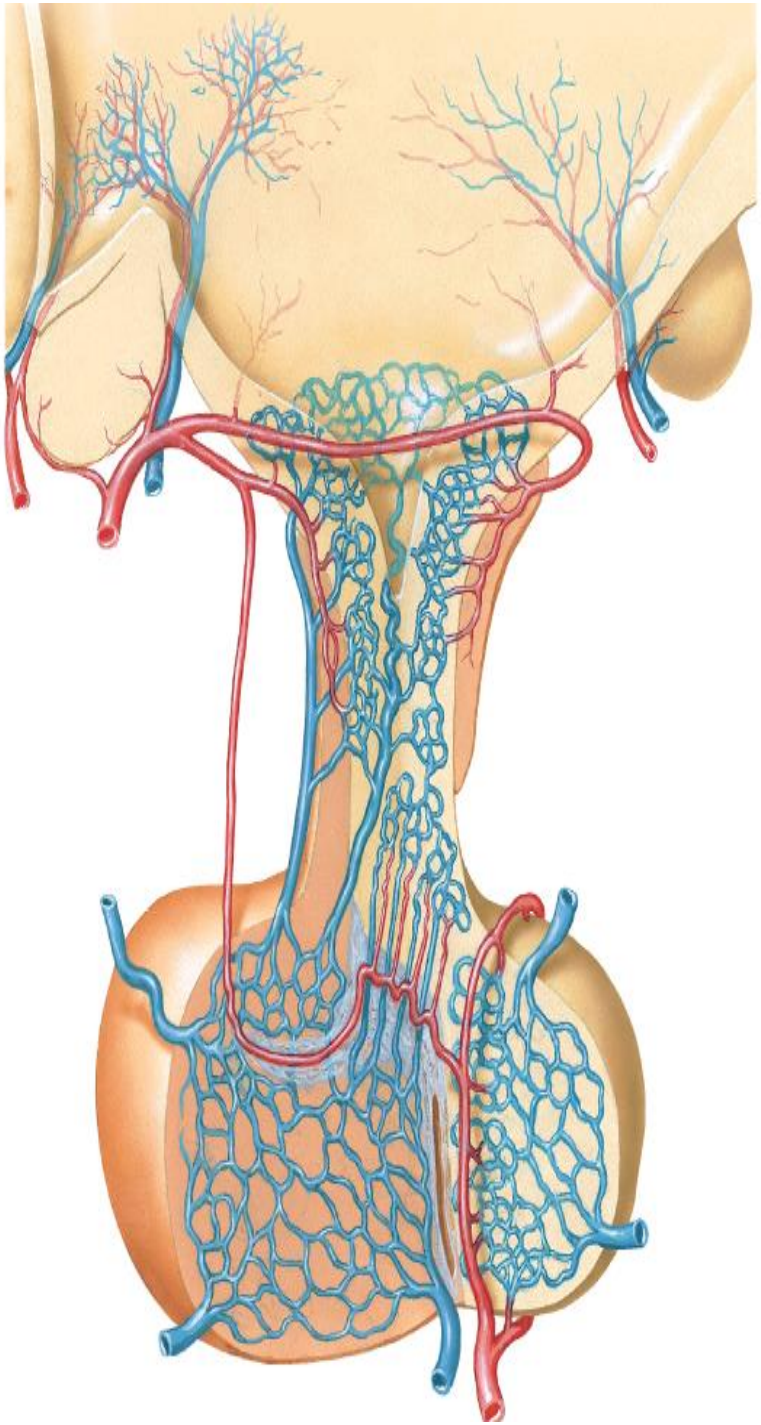
Form an arterial ring around the infundibulum

An important functional observation is that most of the anterior lobe of the pituitary gland has ***no direct arterial supply!!!!!***

because the Ant. lobe is anatomically separated from the hypothalamus

What to do???

A Portal System



if there was not a portal system, the hypothalamus would have communicated with the Ant. lobe in that way .. as you can see, it is a long distance

so the idea behind the portal circulation is to connect the hypothalamus with the Ant.lobe
=>so hormones from hypothalamus can go immediately to Ant.lobe to evoke it to secrete its own hormones

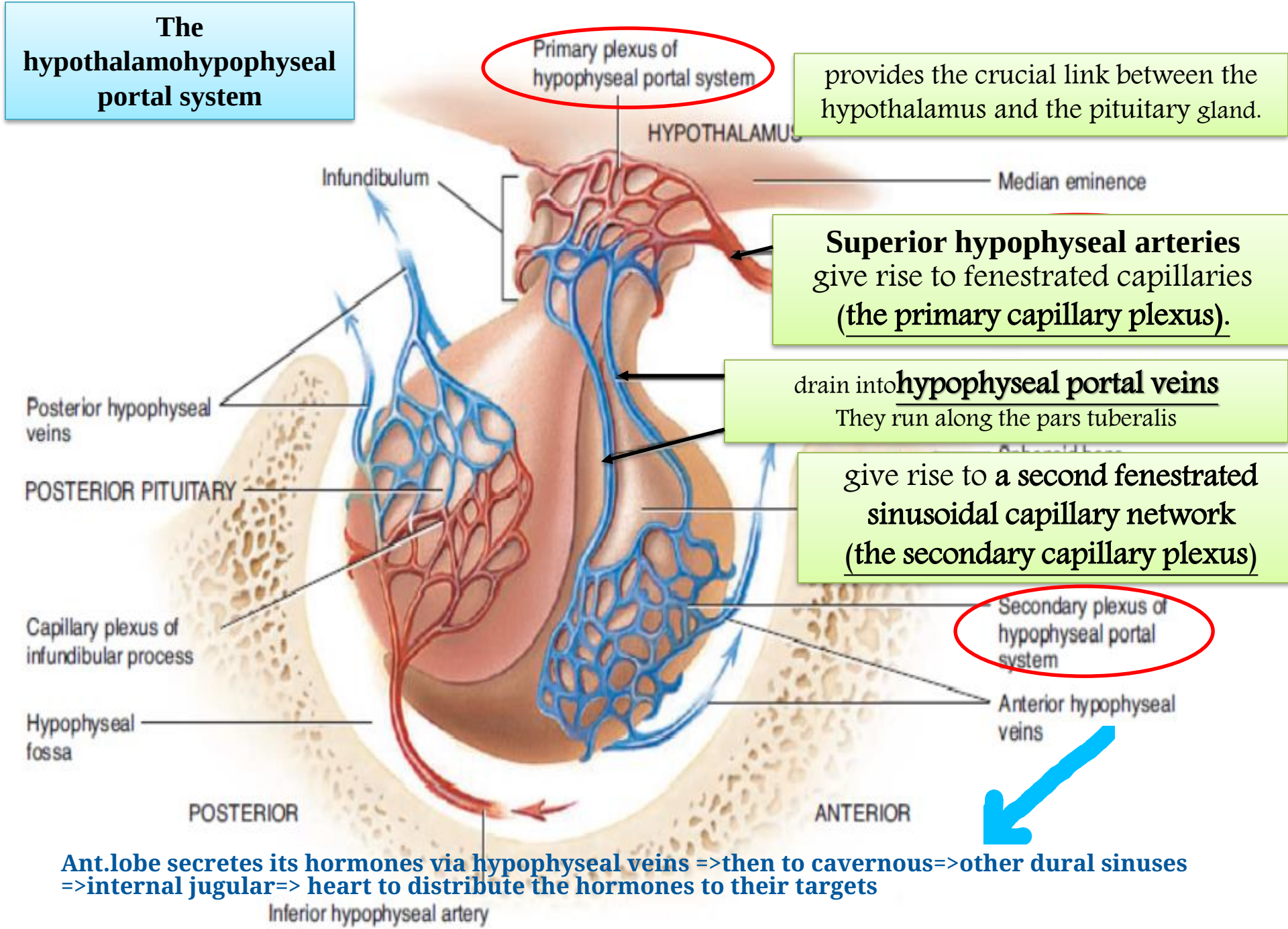
WHAT IS A Portal System?

Usually, blood passes from the heart through an artery to a capillary to a vein and back to the heart.

- In a portal system, blood flows from one capillary network into a portal vein, and then into a second capillary network before returning to the heart. The name of the portal system indicates the location of the second capillary network.

(primary + secondary capillary networks that r connected to each other by portal vein)

The hypothalamohypophyseal portal system



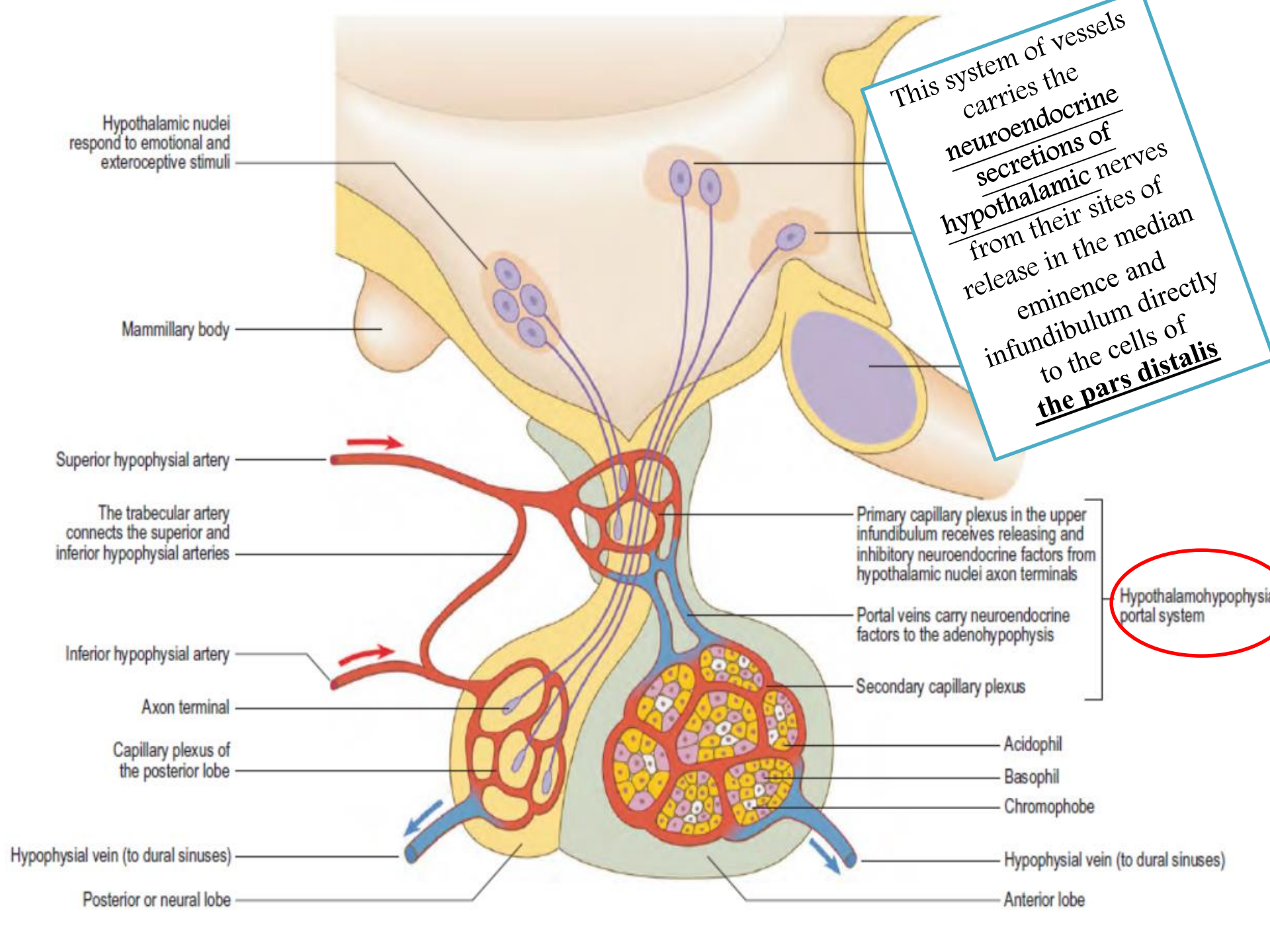
provides the crucial link between the hypothalamus and the pituitary gland.

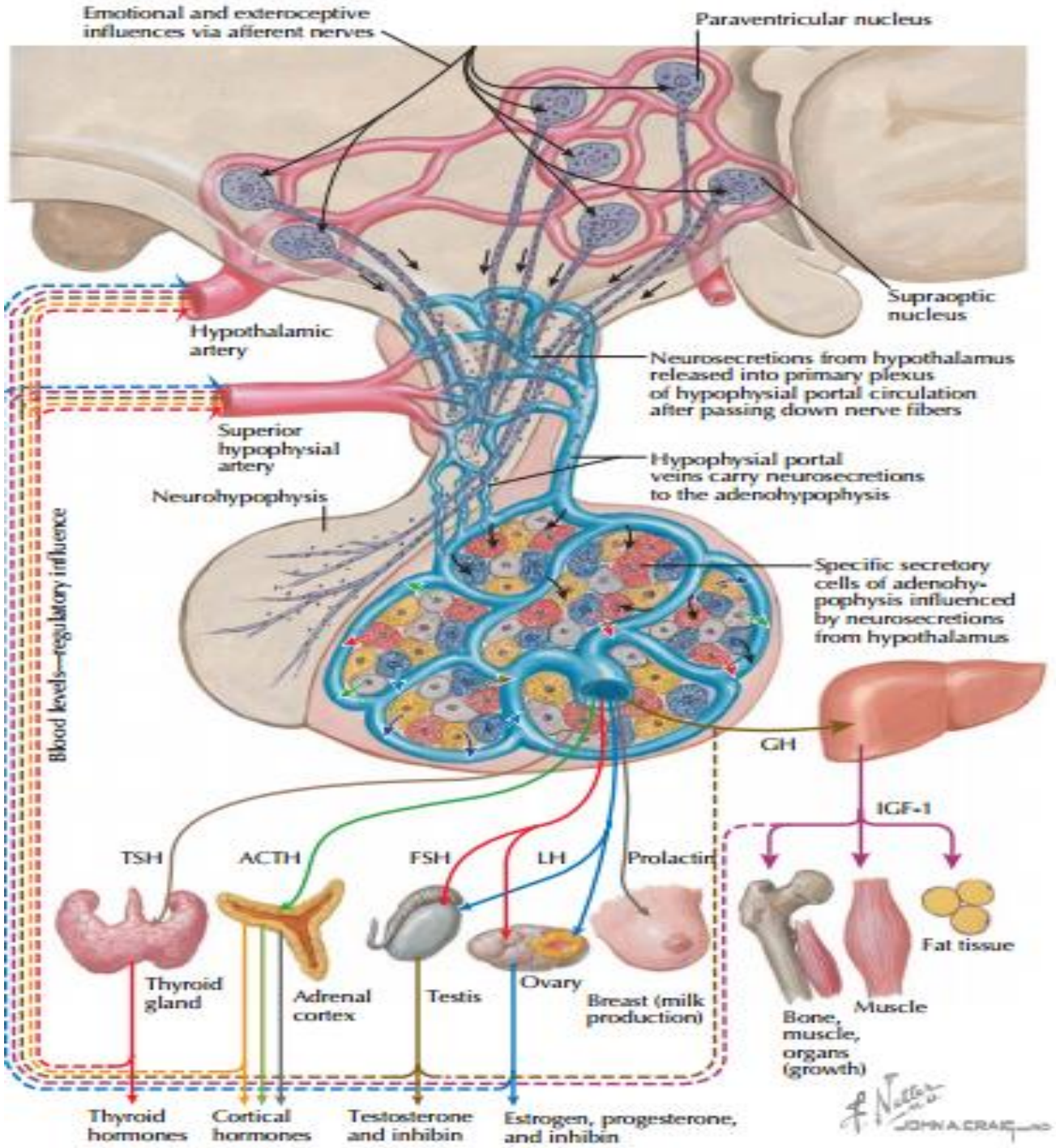
Superior hypophyseal arteries give rise to fenestrated capillaries (the primary capillary plexus).

drain into **hypophyseal portal veins**
They run along the pars tuberalis

give rise to **a second fenestrated sinusoidal capillary network** (the secondary capillary plexus)

Ant.lobe secretes its hormones via hypophyseal veins =>then to cavernous=>other dural sinuses =>internal jugular=> heart to distribute the hormones to their targets

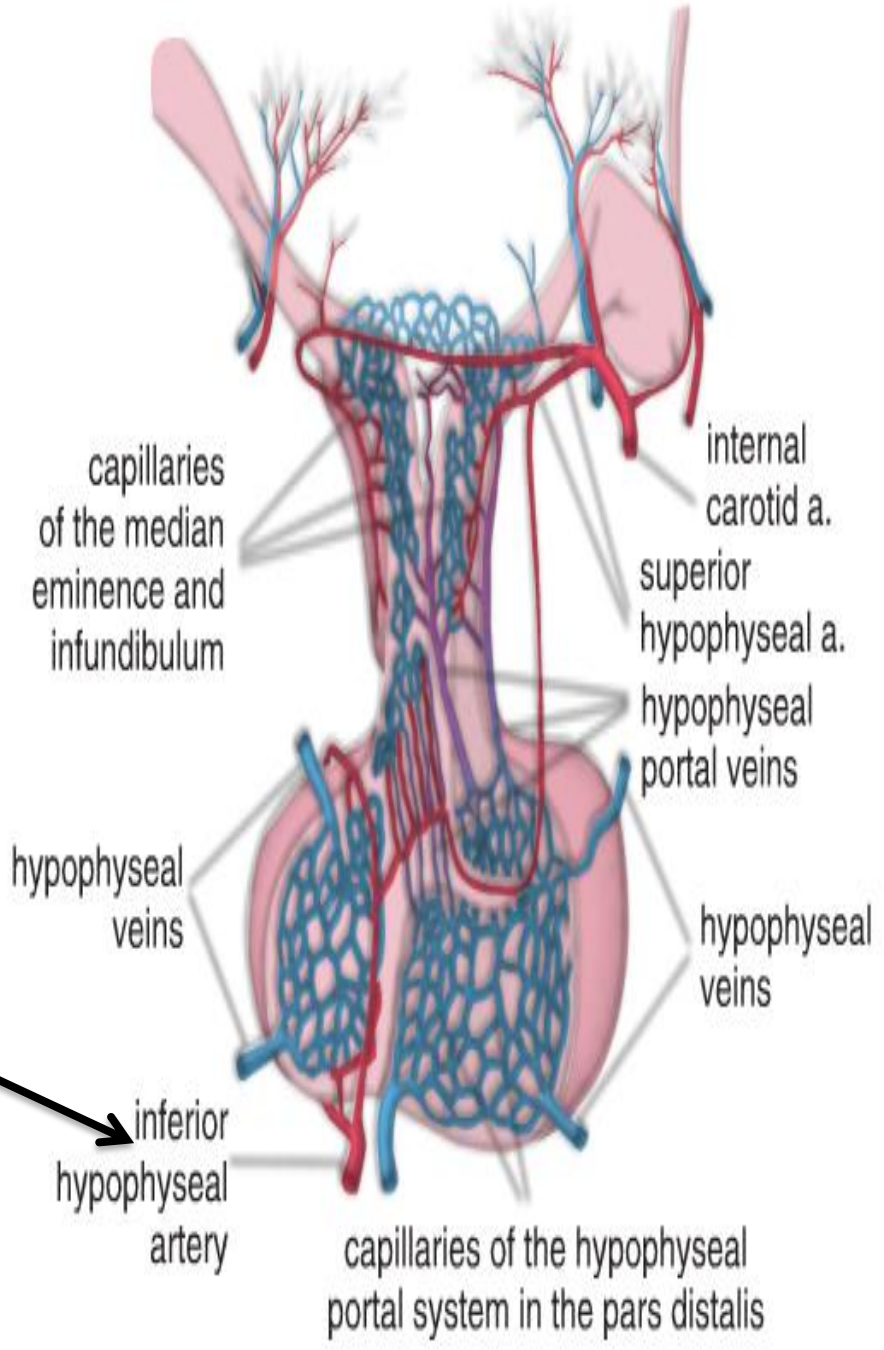

Hypothalamic nuclei respond to emotional and exteroceptive stimuli
Mammillary body
Superior hypophysial artery
The trabecular artery connects the superior and inferior hypophysial arteries
Inferior hypophysial artery
Axon terminal
Capillary plexus of the posterior lobe
Hypophysial vein (to dural sinuses)
Posterior or neural lobe
Primary capillary plexus in the upper infundibulum receives releasing and inhibitory neuroendocrine factors from hypothalamic nuclei axon terminals
Portal veins carry neuroendocrine factors to the adenohypophysis
Secondary capillary plexus
Hypothalamohypophysial portal system
Acidophil
Basophil
Chromophobe
Hypophysial vein (to dural sinuses)
Anterior lobe
This system of vessels carries the neuroendocrine secretions of hypothalamic nerves from their sites of release in the median eminence and infundibulum directly to the cells of the pars distalis


Emotional and exteroceptive influences via afferent nerves
Paraventricular nucleus
Supraoptic nucleus
Hypothalamic artery
Neurosecretions from hypothalamus released into primary plexus of hypophysial portal circulation after passing down nerve fibers
Superior hypophysial artery
Hypophysial portal veins carry neurosecretions to the adenohypophysis
Neurohypophysis
Specific secretory cells of adenohypophysis influenced by neurosecretions from hypothalamus
Blood levels—regulatory influence
GH
IGF-1
TSH
ACTH
FSH
LH
Prolactin
Thyroid gland
Adrenal cortex
Testis
Ovary
Breast (milk production)
Fat tissue
Muscle
Bone, muscle, organs (growth)
Thyroid hormones
Cortical hormones
Testosterone and inhibin
Estrogen, progesterone, and inhibin
JOHN A. CRAIG

B-Inferior hypophyseal arteries

The inferior hypophysial vessels arise solely from
the internal carotid arteries

primarily supply the pars nervosa directly



Inferior hypophyseal arteries

Venous drainage

Most of the blood from the pituitary gland drains into the cavernous sinus and then into the systemic circulation.

Some evidence suggests, however, that blood can flow **via short portal veins from the pars distalis to the pars nervosa and that blood from the pars nervosa may flow toward the hypothalamus**.

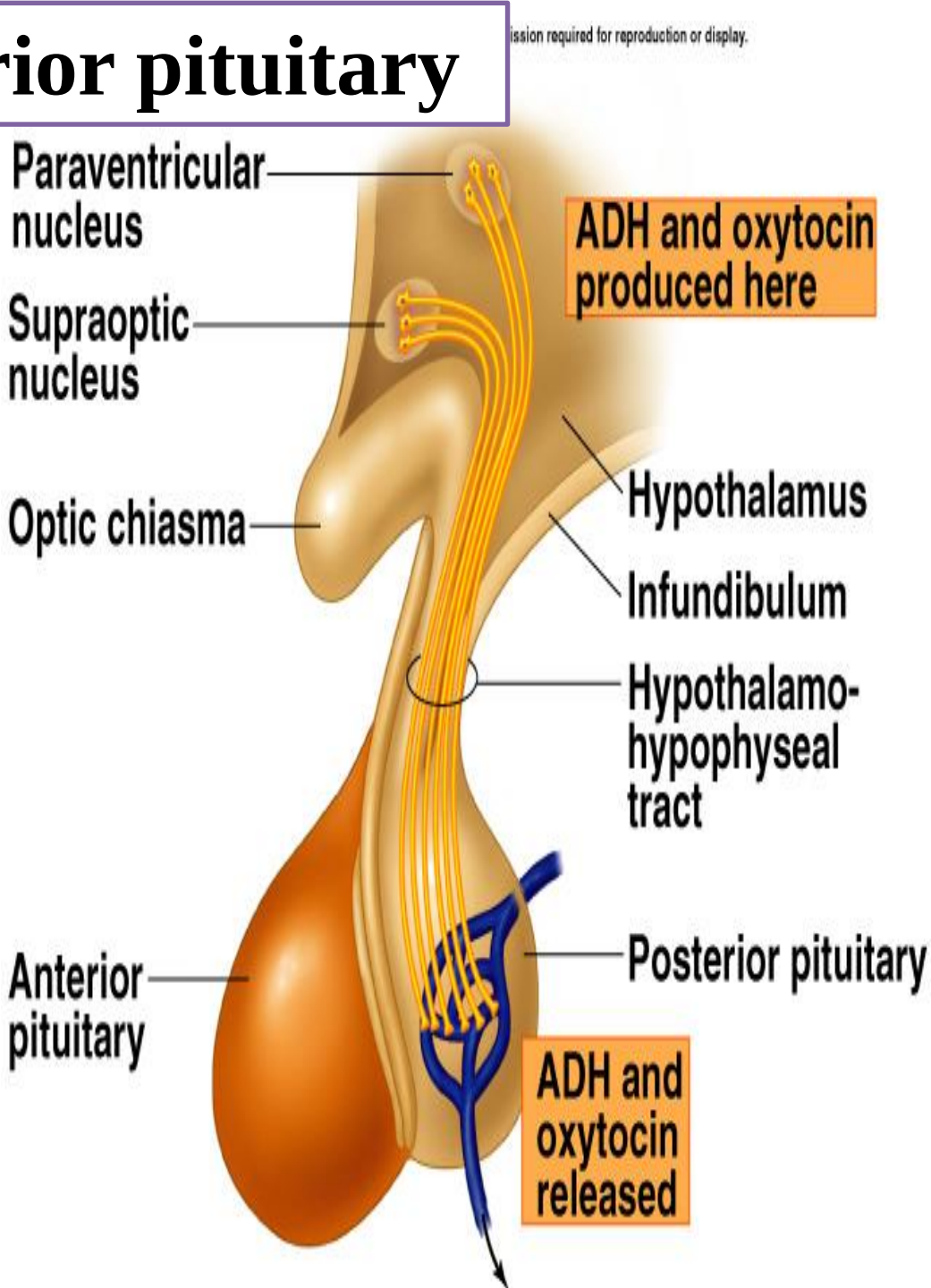
These short pathways provide a route by which the hormones of the anterior lobe of the pituitary gland could provide **feed back** directly to the brain without making the full circuit of the systemic circulation.

=connection between ant. and post. lobes

The posterior pituitary

Neurohypophysis

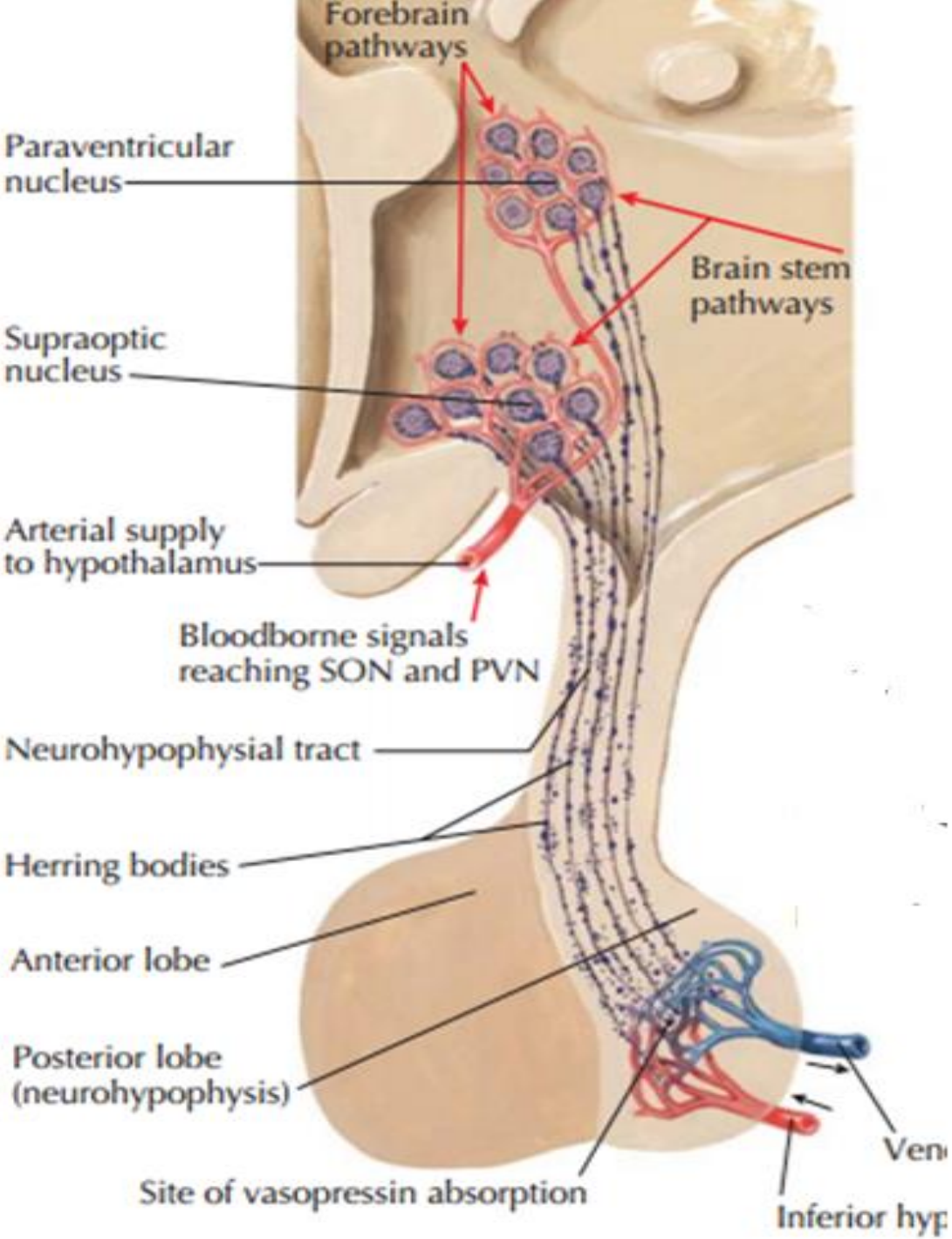
is neural tissue and is formed by the distal axons of
<u>The supraoptic nucleus (SON)</u>
and
<u>The paraventricular nucleus (PVN)</u>
of the hypothalamus.



The axon terminals store neurosecretory granules that contain vasopressin

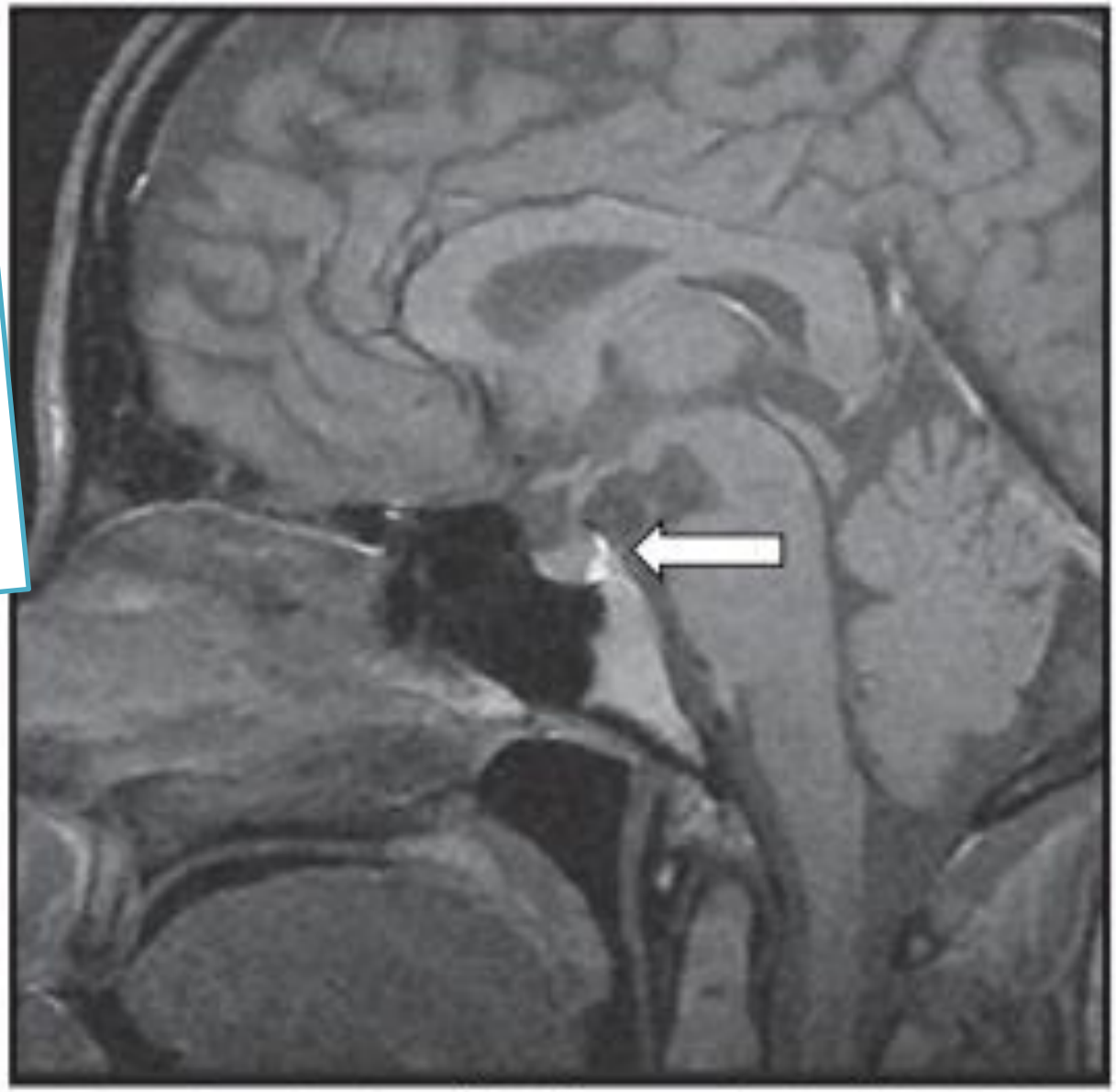
The blood supply for the posterior pituitary is from the inferior hypophysial arteries

The venous drainage is into the cavernous sinus and internal jugular vein



The stored vasopressin in neurosecretory granules in the posterior pituitary produces a bright signal on (MRI) **the "posterior pituitary bright** spot."

The posterior pituitary bright spot is present in most healthy individuals and is absent in individuals with central diabetes insipidus.



Posterior pituitary bright spot. Sagittal T1-MRI image showing hyperintensity (arrow) in the posterior aspect of the sella turcica.

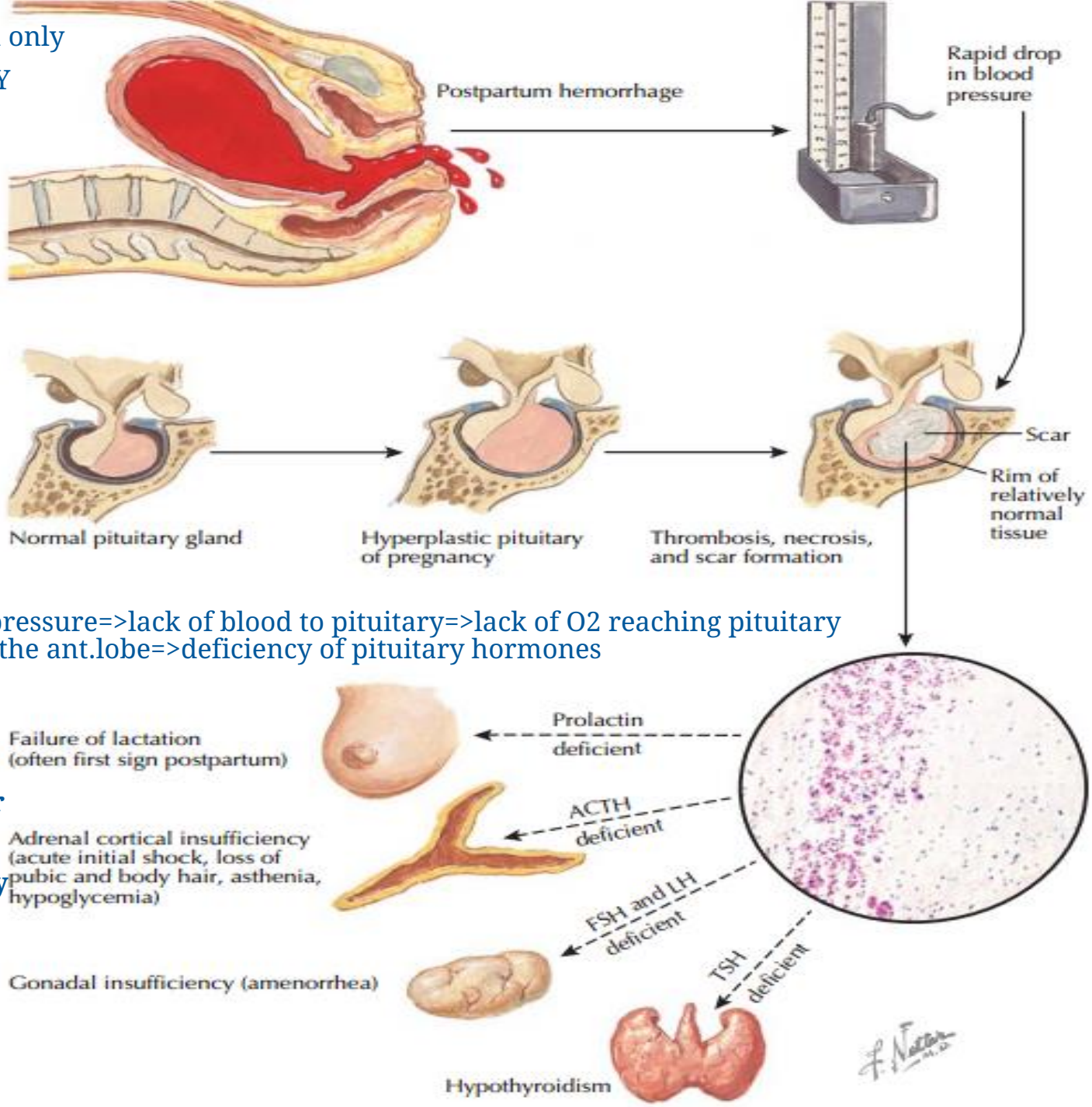
some healthy individuals could have absent "post.pituitary bright spot"
==> so when it is absent, u have to do more investigations before u confirm the DX of central diabetes insipidus

Clinical applications

*it affects pregnant women only

*bleeding during DELIVARY must occur to develop sheehan syndrome

(SHEEHAN SYNDROME



hemorrhage=>low blood pressure=>lack of blood to pituitary=>lack of O2 reaching pituitary =>necrosis and fibrosis of the ant.lobe=>deficiency of pituitary hormones

the woman comes to your clinic complainig of inability to breastfeed because of the defficiency of prolactin due to the damaged pituitary

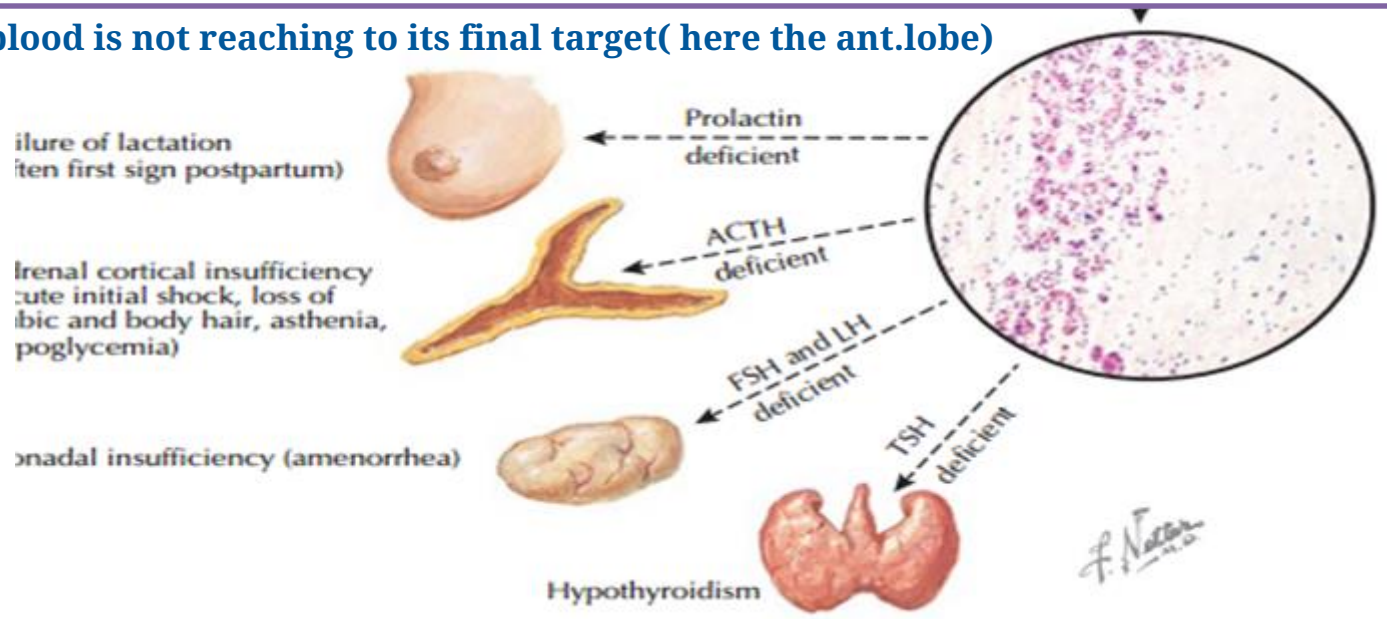
The pituitary gland enlarges during pregnancy (primarily because of lactotroph hyperplasia) **preparing for breastfeeding**

portal venous blood supply is uniquely vulnerable to changes in arterial blood pressure

severe postpartum uterine hemorrhage, spasm of the infundibular arteries, which are drained by the hypophysial portal vessels,.

could result in pituitary infarction.
If the lack of blood flow continued for several hours, most of the tissues of the anterior pituitary gland infarcted; when blood finally started to flow, stasis and thrombosis occurred in the stalk and the adenohypophysis

infarction=blood is not reaching to its final target(here the ant.lobe)



Pituitary Adenoma

The optic chiasm lies above the diaphragma sellae.

The most common sign that a pituitary tumor has extended beyond the confines of the sella turcica

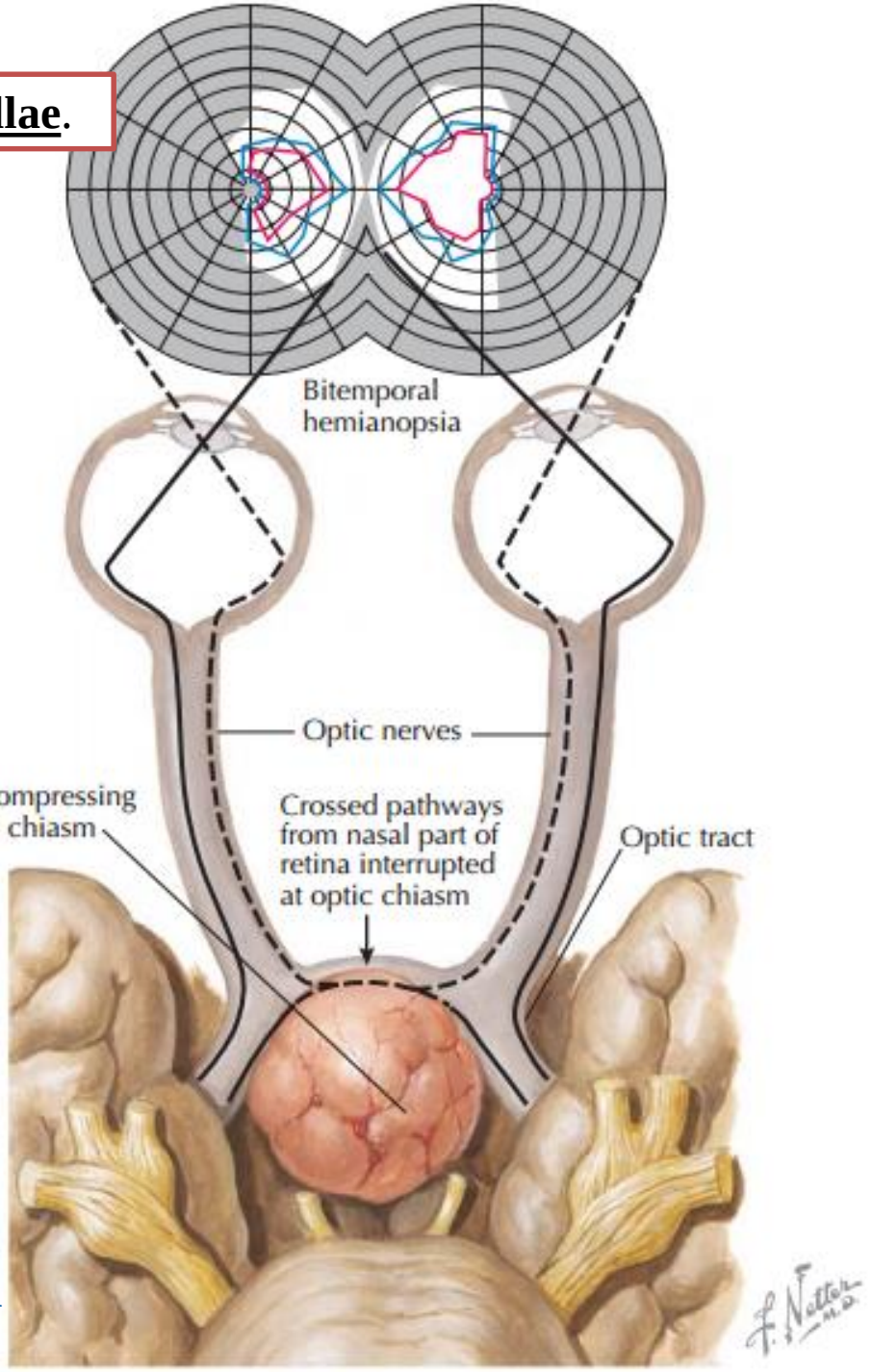
is a visual defect caused by the growth pressing on the optic chiasm..

The most frequent disturbance is a **Bitemporal hemianopsia**

which is produced by the tumor pressing on the crossing central fibers of the chiasm and sparing the uncrossed lateral fibers.

pituitary adenoma is

more common in females due to lactation menstrual cycle & pregnancy



Bitemporal hemianopsia

asymptomatic pituitary adenoma is common

A city as seen with bitemporal hemianopsia.

Adenoma= increase in size and applying more pressure on nearby structures

the growing mass has 2 options.. either to go

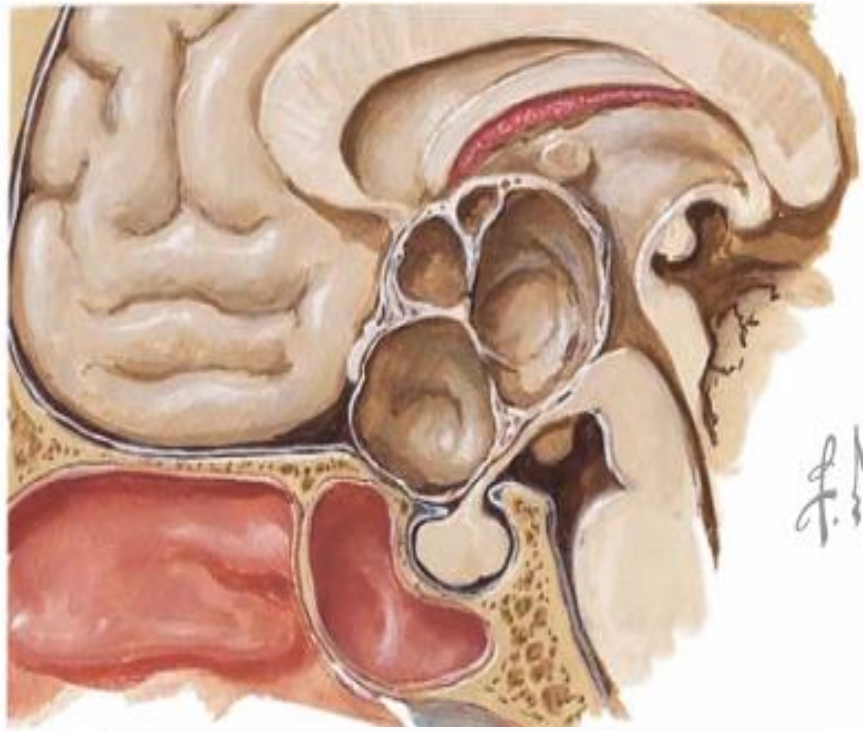
superiorly (optic chiasma) ✓

inferiorly(hypophyseal fossa) ✗

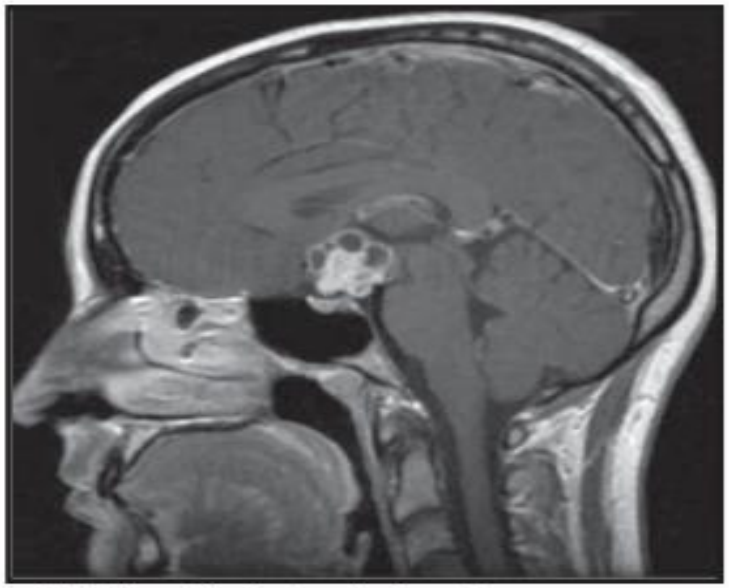
of course the mass will choose the area of less resistance.. which is the optic chiasma (it cannot go inferiorly through the bone)

Craniopharyngioma

is the most common tumor found in the region of the pituitary gland in children and adolescents and constitutes about 3% of all intracranial tumors and up to 10% of all childhood brain tumors.



Craniopharyngiomas histologically benign epithelioid tumors arising from embryonic **squamous remnants of Rathke pouch—may** be large (e.g., > 6 cm in diameter) and invade the third ventricle and associated brain structures.



MRI (sagittal view) showing cystic suprasellar craniopharngioma

u just have to memorize that craniopharyngioma is related to Rathkle pouch.

diseases around the pituitary gland are classified to:

1 Suprasellar

↓

Hypothalamic manifestations (obesity, somnolence) with or without hypopituitarism and/or diabetes insipidus

2 Intrasellar anterior lobe

↓

Anterior lobe hypofunction of variable degree

3 Intrasellar posterior lobe

↓

Diabetes insipidus

localized in hypophyseal fossa

trauma to the connection between the post.lobe & hypothalamus (the fibers there are very delicate)

Trauma

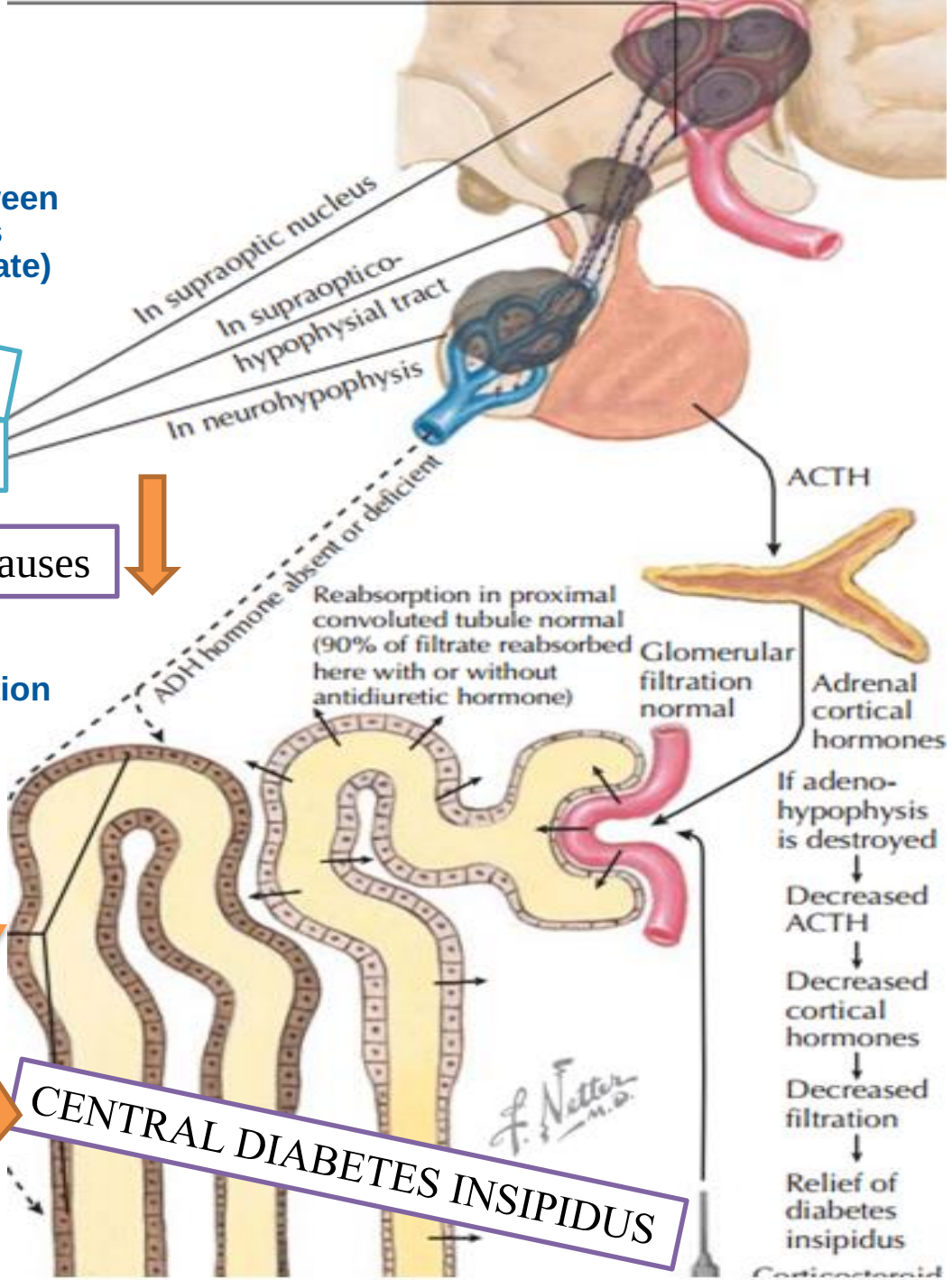
Tumor

Other causes

ADH=> reabsorbs water so we dont lose it during filtration

a trauma to that area causes ADH deficiency, so

Reabsorption of water in cortical and medullary collecting ducts lost in absence of ADH



CENTRAL DIABETES INSIPIDUS

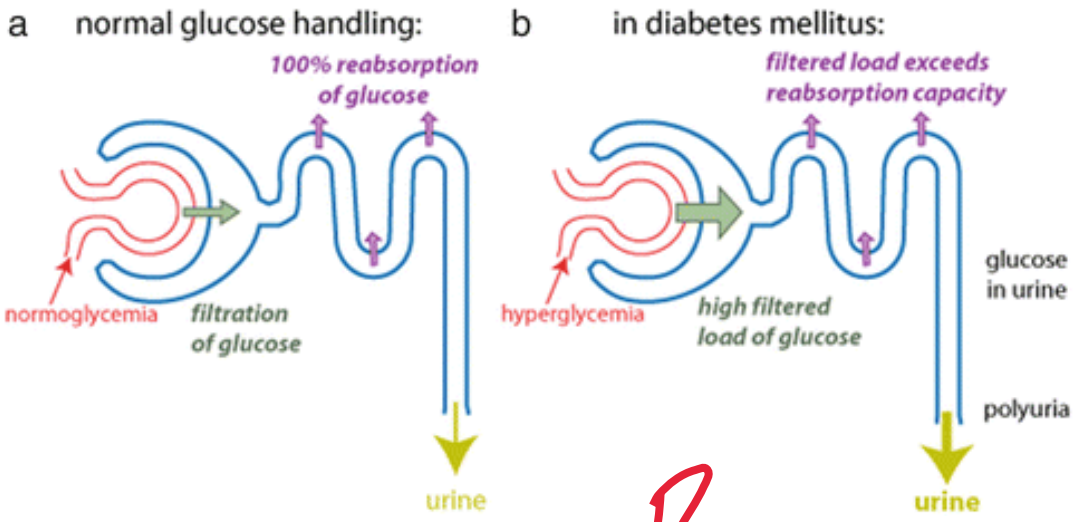
both central diabetes insipidus and DM cause polyuria (excessive production of urine)

in central diabetes insipidus, polyuria is due to ADH deficiency
==> little or no absorption of water

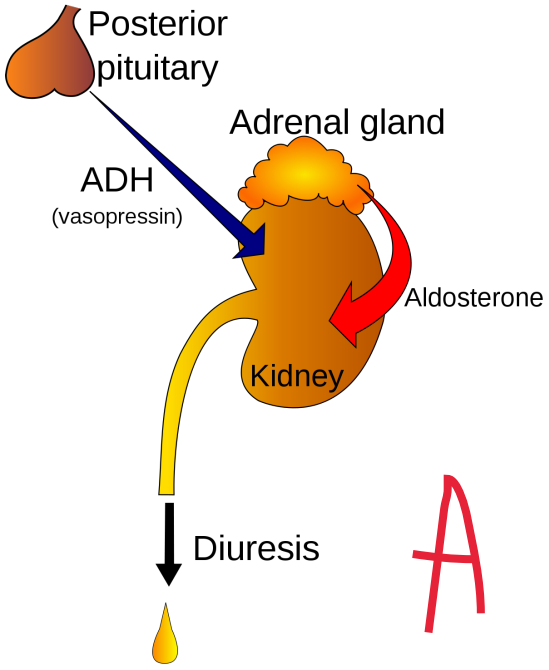
A

in DM:
when glucose levels are so high that glucose is excreted in the urine.
Water follows the glucose concentration passively, leading to abnormally high urine output.

B



B

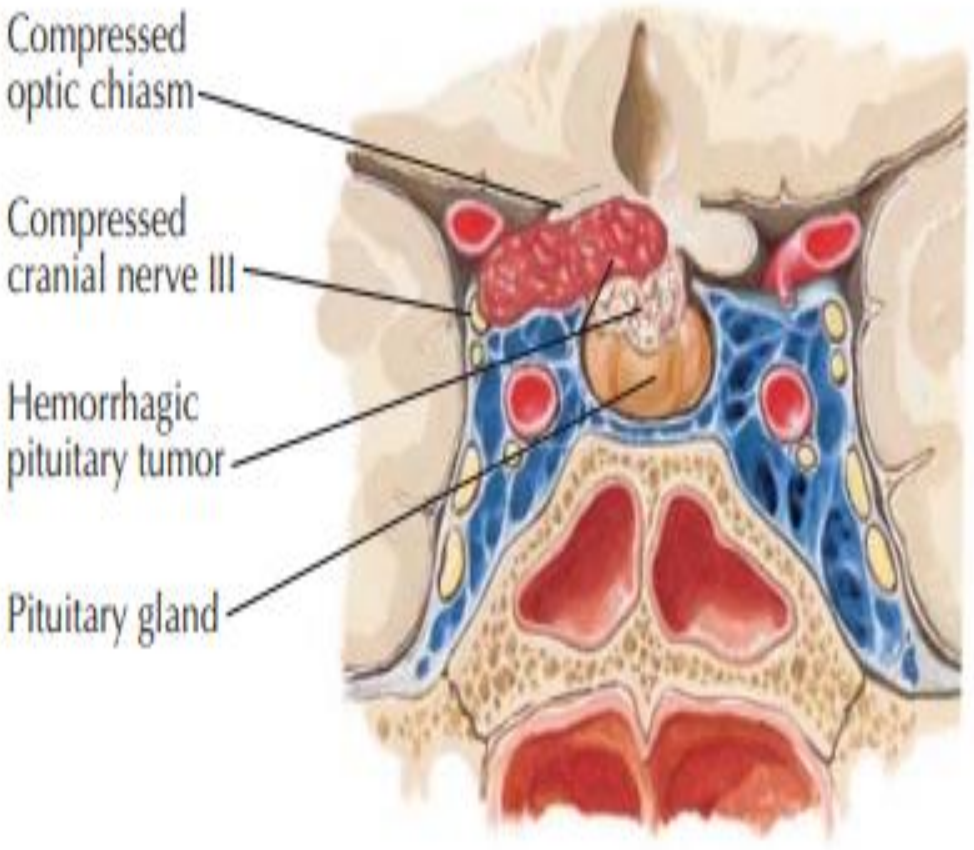


A

PITUITARY APOPLEXY

acute hemorrhage of the pituitary gland

The typical presentation is acute onset of severe headache (frequently described as "the worst headache of my life")
vision loss
(the hemorrhagic
expansion takes the path **of least resistance and extends**
superiorly and compresses the optic chiasm);
ocular nerve palsies (e.g.,
ptosis, diplopia) caused by **impingement of the third,**
fourth, and sixth cranial nerves in the cavernous sinuses



we dont worry about the amount of blood that is lost.
instead, we worry about the applied pressure
on the nearby structures

in comparison to adenoma:

pituitary apoplexy expands faster
the pressure is applied by fluid(in adenoma=by the growing mass)