

Department of Anatomy and Histology

School of Medicine

The University of Jordan

Endocrine system



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Objectives

- 1. Recognize and understand the main parts of the pituitary gland and their locations, relations and connections.**
- 2. Comprehend the blood supply of the pituitary gland and its portal circulation.**
- 3. Understand the embryological origins of the pituitary gland.**
- 4. Grasp the clinical correlations of the pituitary gland on anatomical basis and its surgical approach.**
- 5. Recognize and understand imaging of the pituitary gland.**
- 6. Grasp the histological structure of the pituitary gland and its cells under light and electron microscopes.**
- 7. Recognize and understand the location, simple structure of the hypothalamus and its connections**

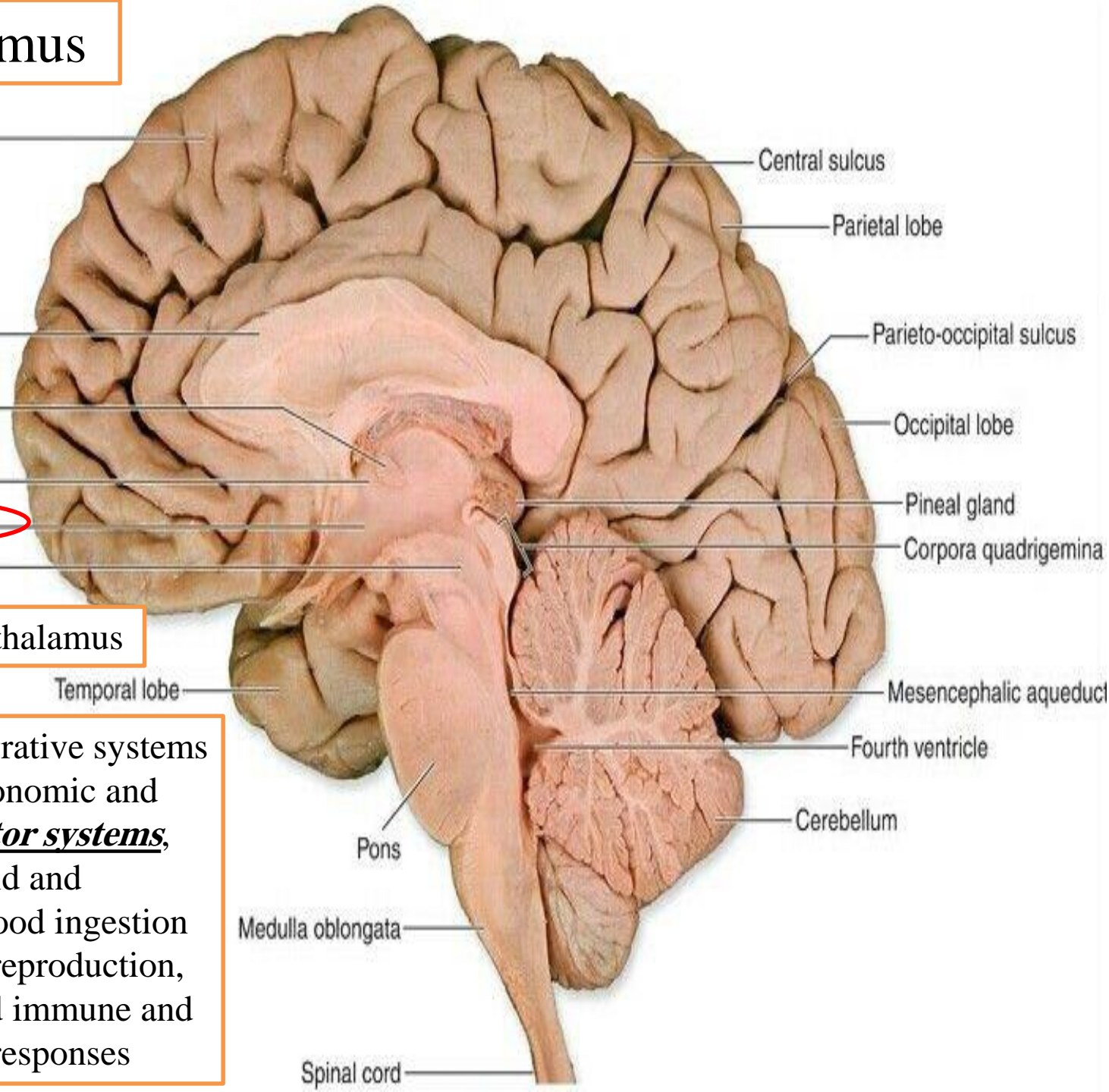
The hypothalamus

- consists of only 4 cm, 0.3% of the total brain

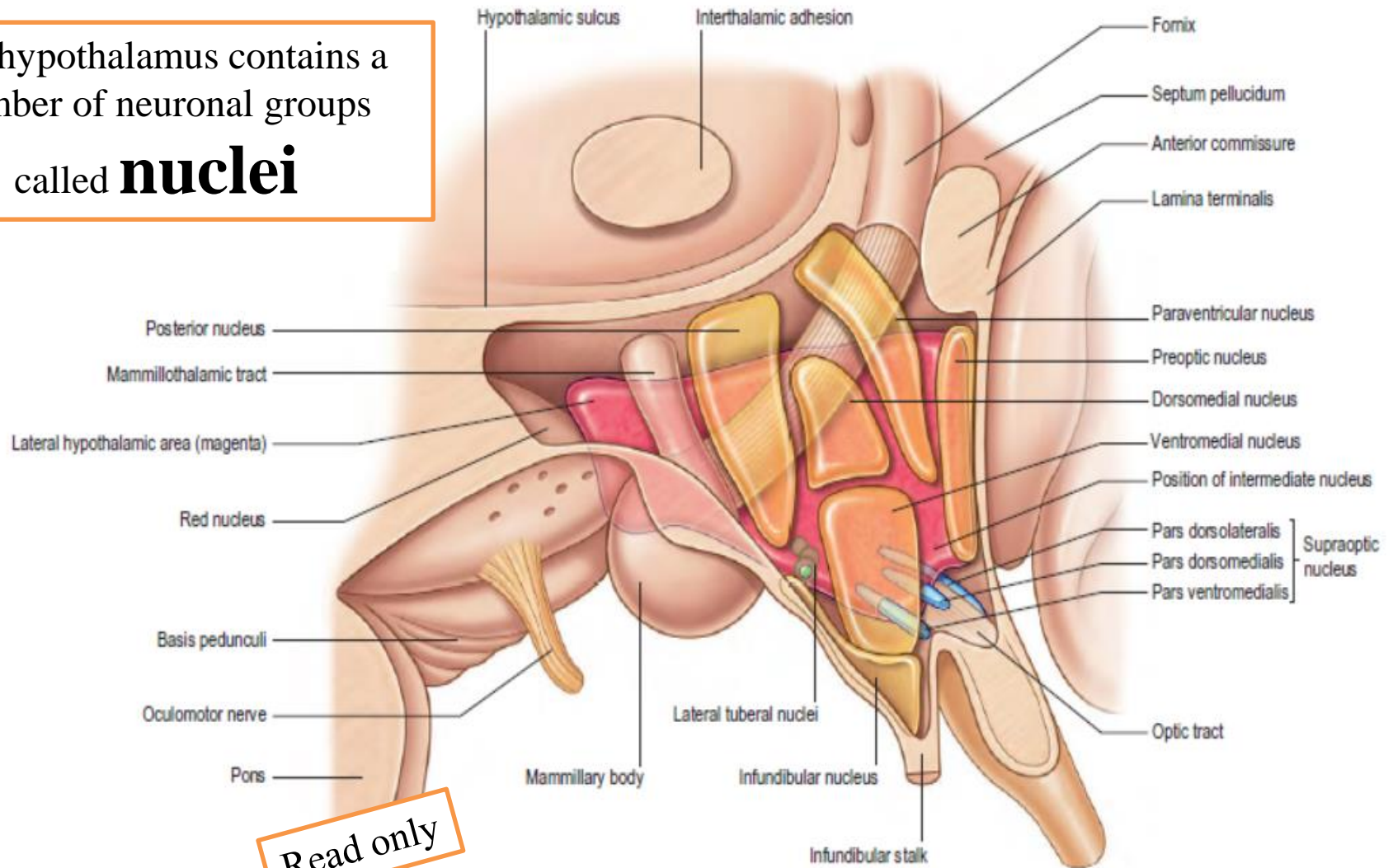
Corpus callosum
Interthalamic adhesion
Thalamus
Hypothalamus
Mesencephalon

- It lies beneath the thalamus

- It contains the integrative systems that, via the autonomic and **endocrine effector systems**, control fluid and electrolyte balance, food ingestion and energy balance, reproduction, thermoregulation, and immune and many emotional responses



The hypothalamus contains a number of neuronal groups called **nuclei**



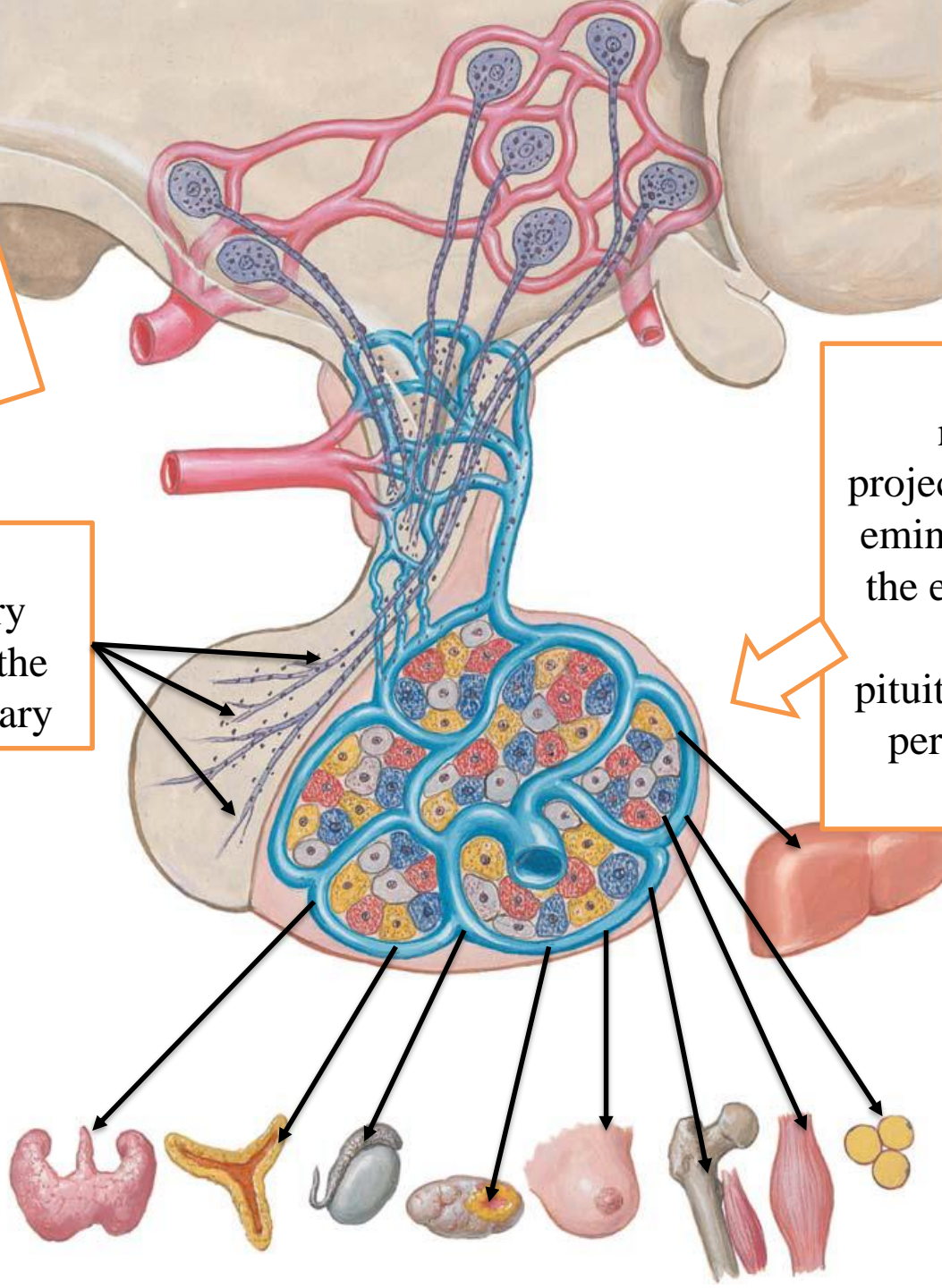
Read only

Fig. 21.8 The hypothalamic region of the left cerebral hemisphere viewed from the medial aspect and dissected to display the major hypothalamic nuclei. In the upper diagram the medially placed nuclear groups have been removed; in the lower diagram both lateral and medial groups are included. Lateral to the fornix and the mammillothalamic tract is the lateral hypothalamic region, in which the tuberomammillary nucleus is situated posteriorly, and the lateral preoptic nucleus rostrally. Surrounding the fornix is the perifornical nucleus, which joins the lateral hypothalamic area with the posterior hypothalamic nucleus. The medially placed nuclei (yellow) fill in much of the region between the mammillothalamic tract and the lamina terminalis, but also project caudal to the tract. The lateral tuberal nuclei are situated ventrally, largely in the lateral hypothalamic area. The supraoptic nucleus may form three rather separate parts. The intermediate nuclei form three groups between the supraoptic and paraventricular nuclei. (Modified from Nauta WJH, Haymaker W 1969 Hypothalamic nuclei and fibre connections. In: Haymaker W, Anderson E, Nauta WJH (eds) *The Hypothalamus*, by permission of Charles C Thomas Publisher, Ltd, Springfield, Illinois.)

The hypothalamus controls the endocrine system in a variety of ways:

A-Through neurosecretory projections to the posterior pituitary

B-Through neurosecretory projections to the median eminence (these control the endocrine output of the anterior pituitary and thereby the peripheral endocrine organs)



THE PITUITARY GLAND



also known as the HYPOPHYSIS



Master organ????

Different names

الغدة النخامية

The pituitary

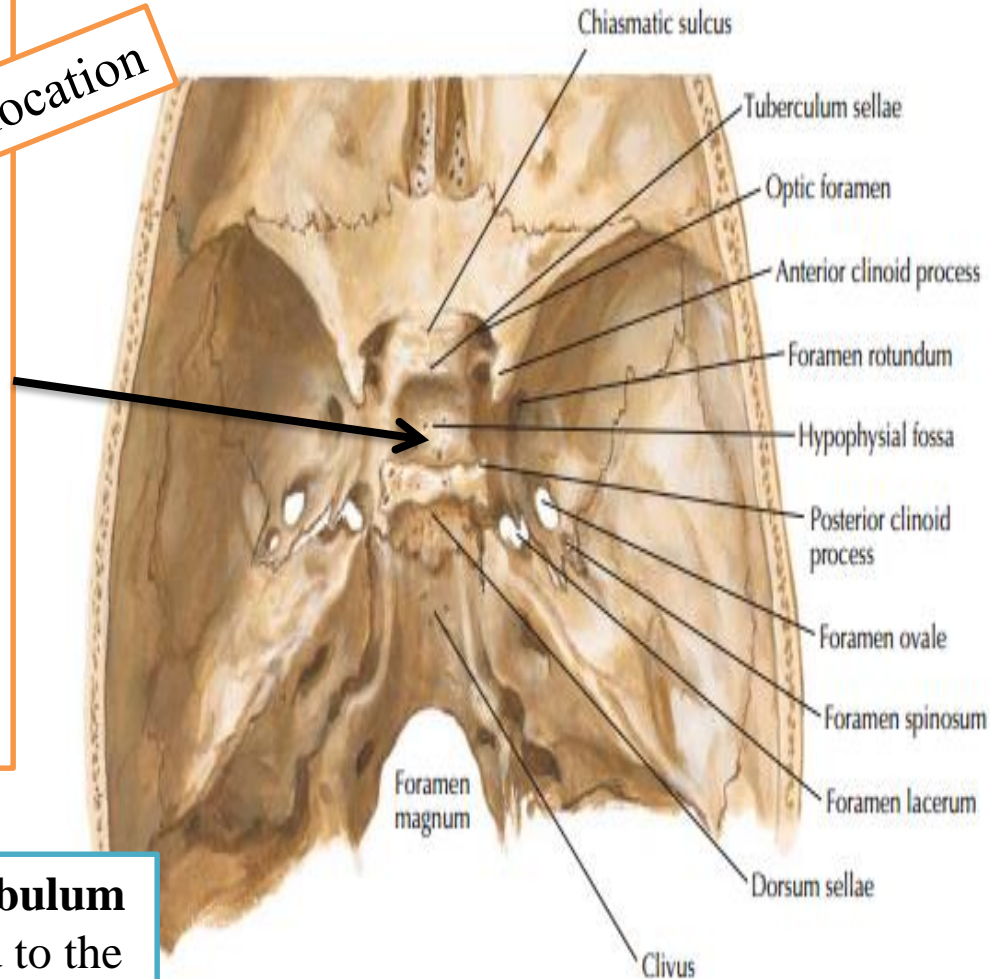
- It is a pea-sized
- Weighs 0.5 g in males and 1.5 g in multiparous women

➤ It is centrally located at the base of the brain, where it lies in a **saddle-shaped depression** of the sphenoid bone called

THE SELLA TURCICA

location

➤ A short stalk, the **infundibulum** connects the pituitary gland to the hypothalamus.

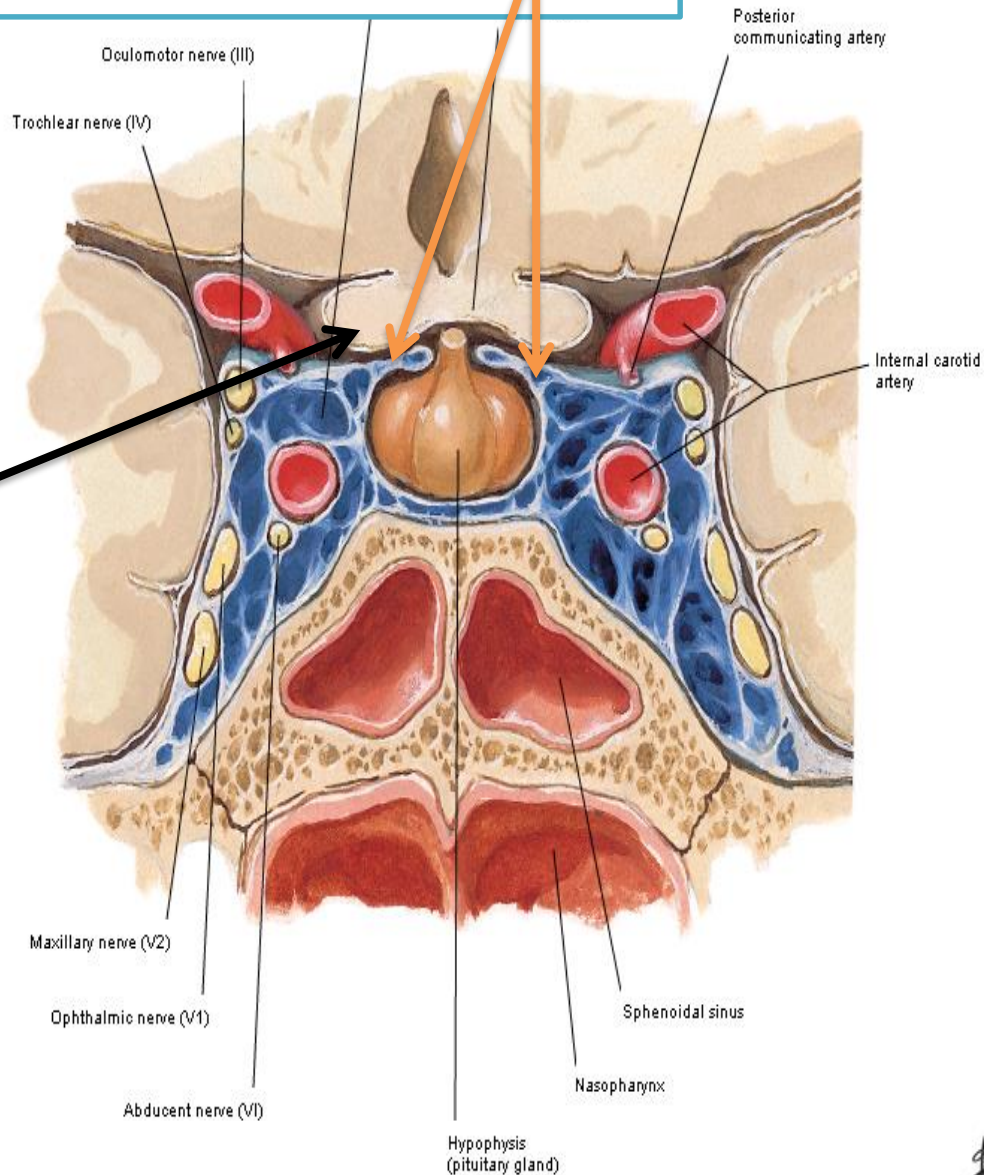


Gross Anatomy

Superiorly

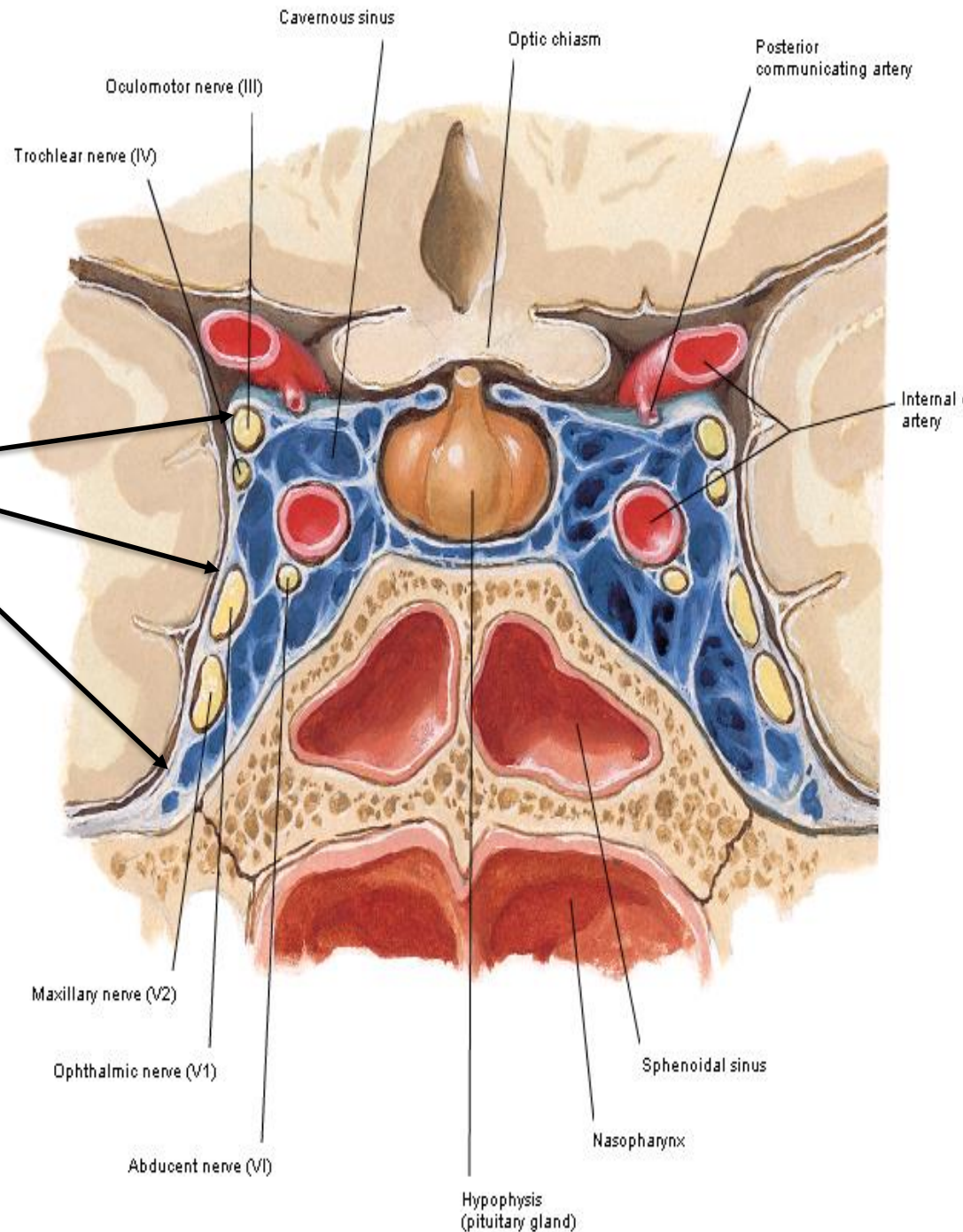
➤ A circular fold of dura mater, the **diaphragma sellae** forms the roof of this fossa

➤ The diaphragma sellae is pierced by a small central aperture through which the pituitary stalk passes, and it separates the anterior part of the upper surface of the gland from the optic chiasma.

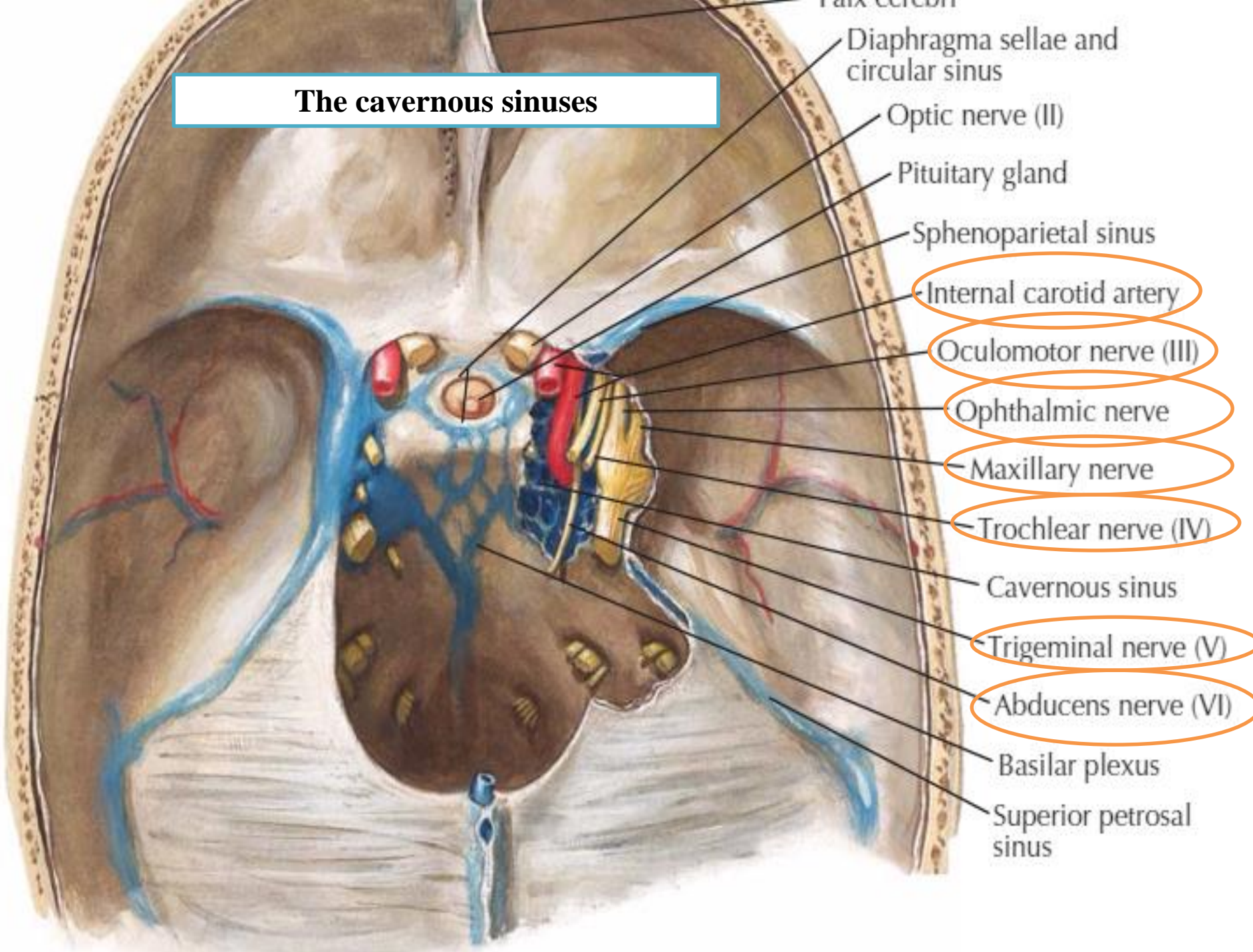


Laterally

➤ The hypophysis is bound on each side by **The cavernous sinuses** and the structures that they contain.



The cavernous sinuses



Structures Passing on lateral wall of the cavernous sinus

Cranial nerve number (3) oculomotor nerve

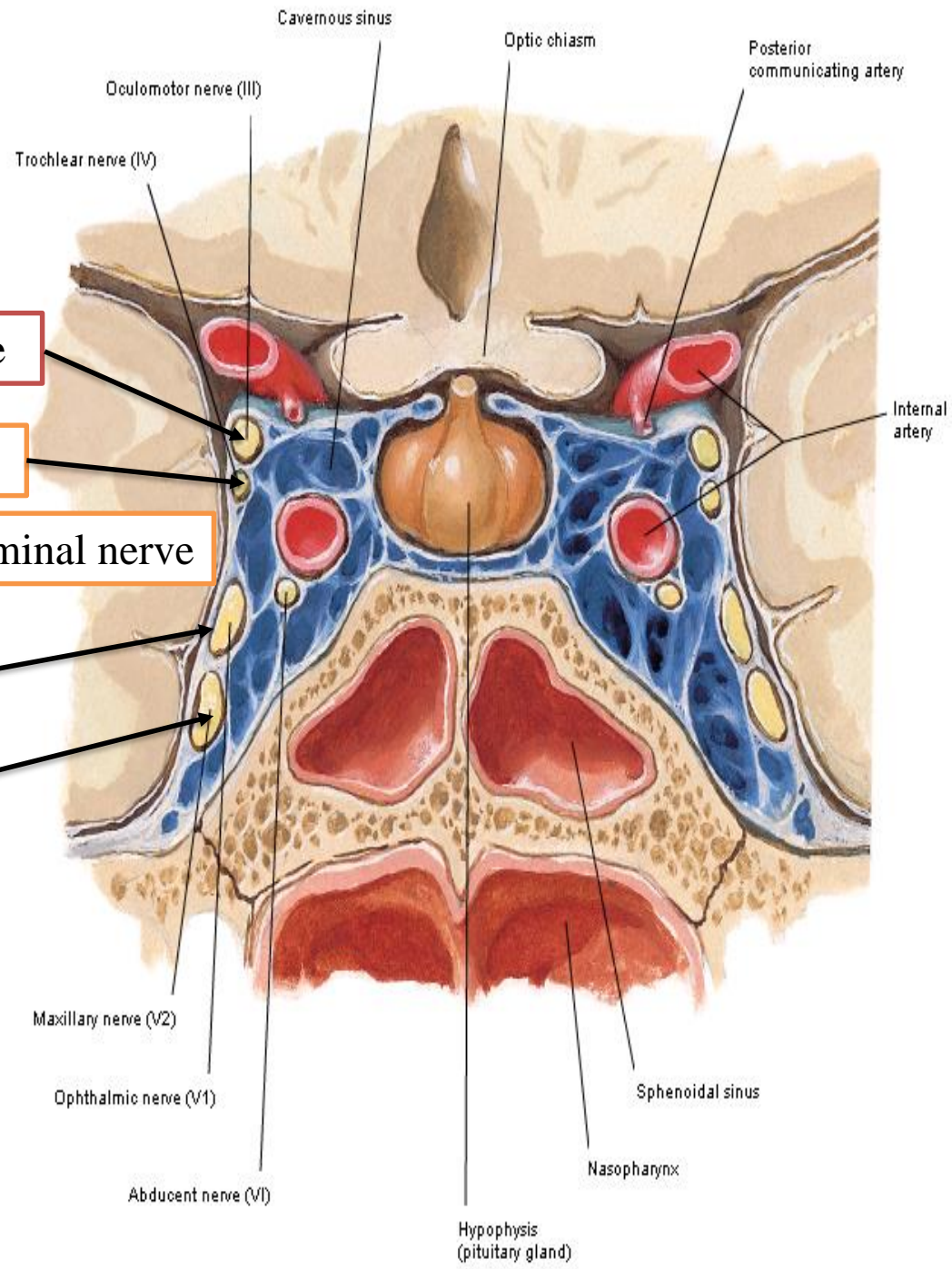
Cranial nerve number (4) Trochlear nerve

Divisions of Cranial nerve number (5) trigeminal nerve

Ophthalmic nerve

Maxillary nerve

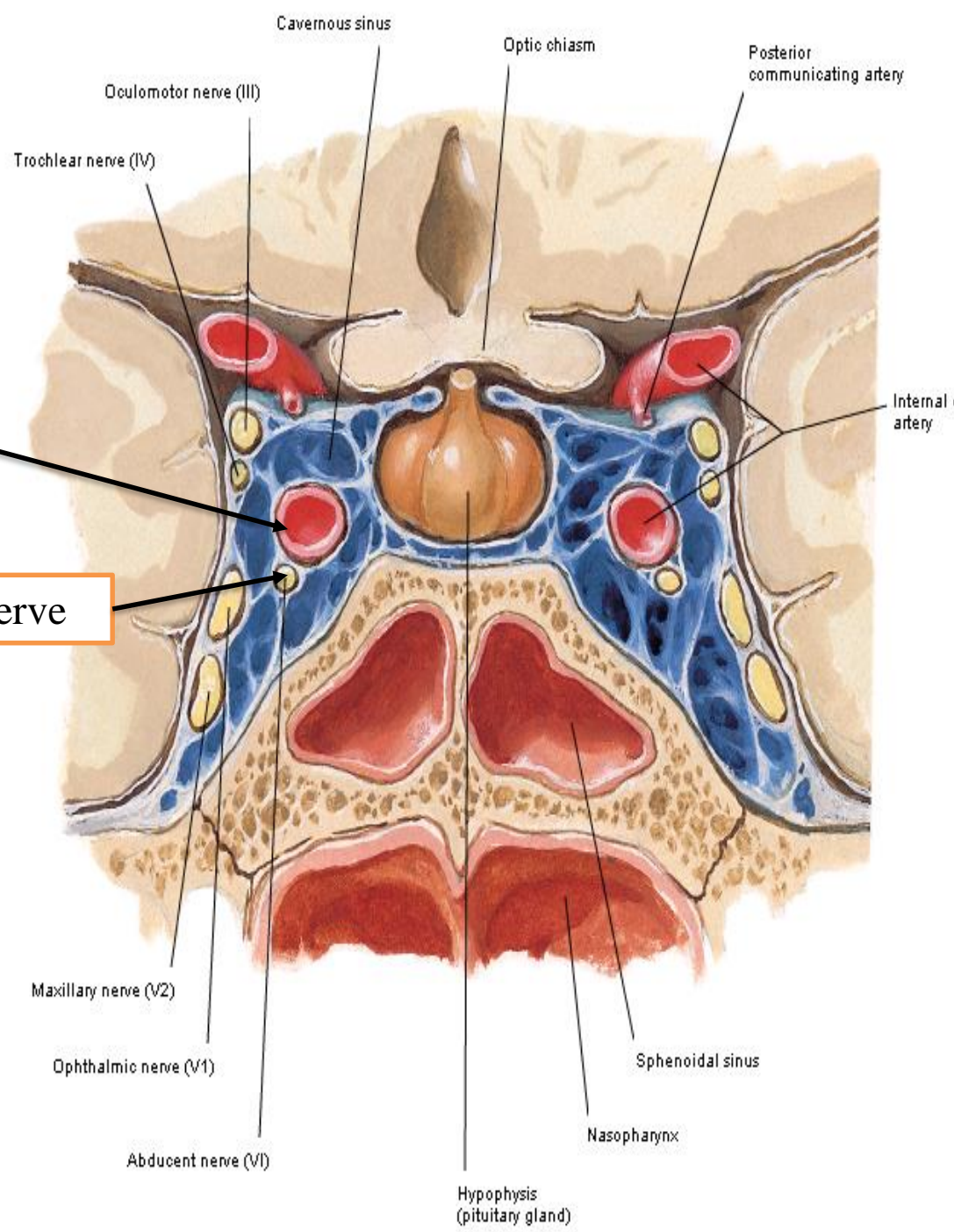
How about the mandibular nerve?



Structures inside the cavernous sinus

The internal carotid artery

The cranial nerve number (6) abducent nerve

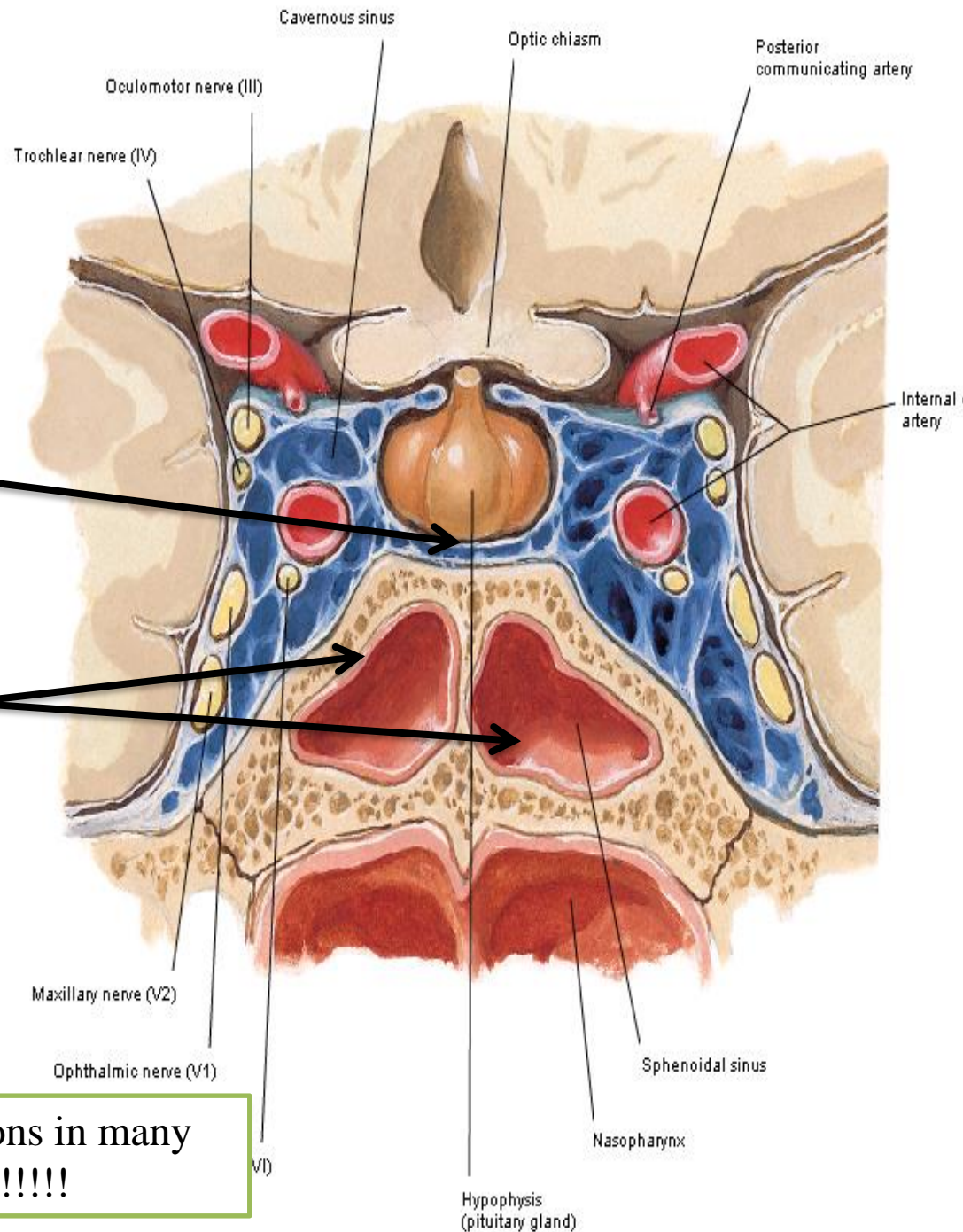


Inferiorly

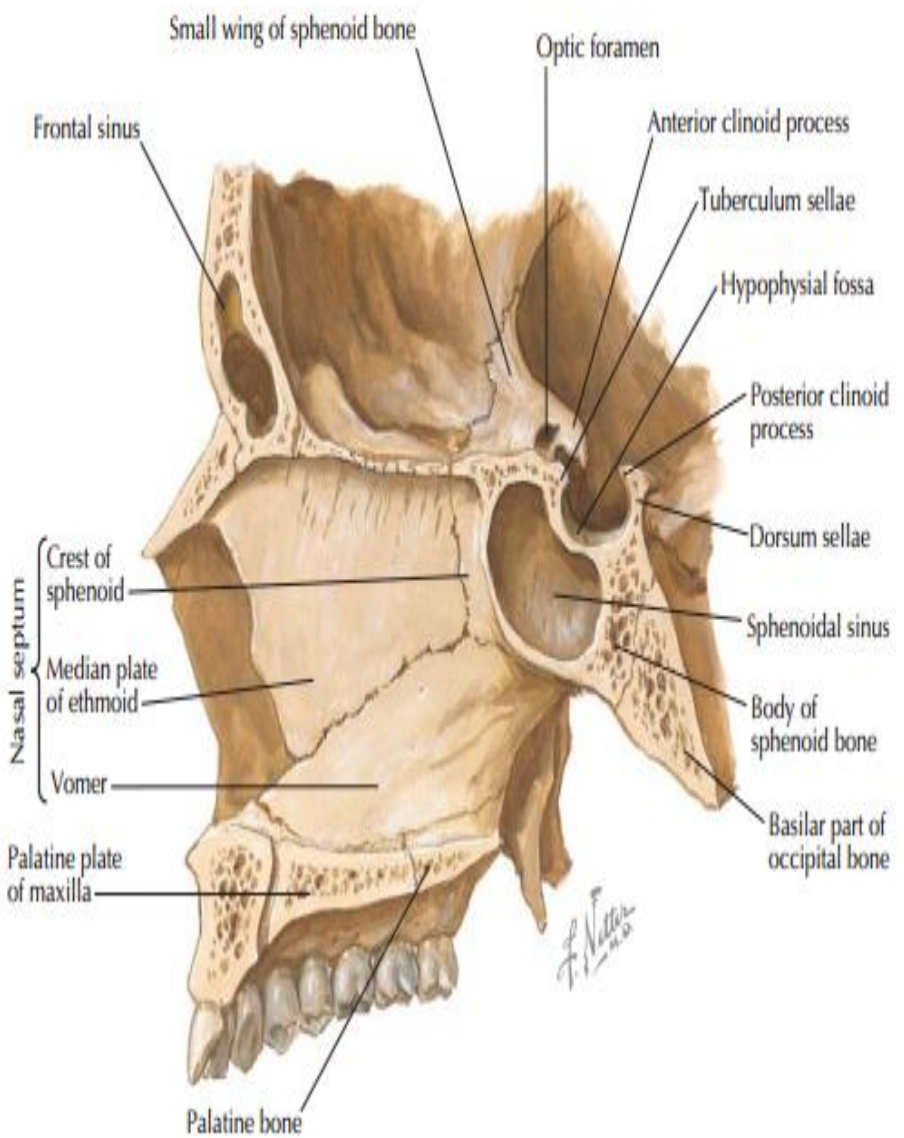
➤ it is separated from the floor of the fossa by a large, partially vacuolated venous sinus

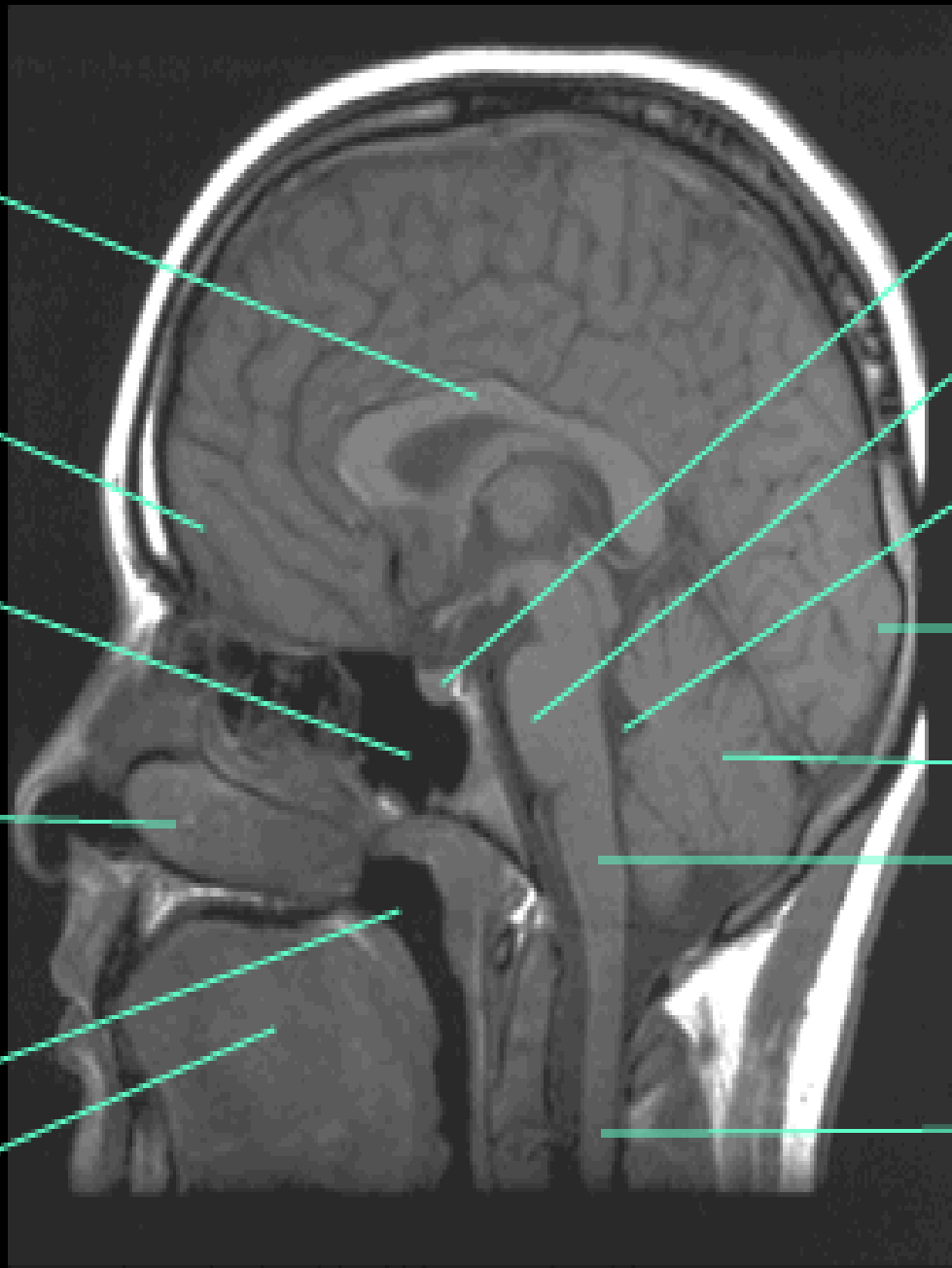
The sphenoid air sinus

endoscopic transnasal applications in many pituitary surgical centers!!!!



Radiology





Corpus callosum

The pituitary

Frontal pole

Pons

Sphenoid sinus

Fourth ventricle

Occipital pole

Inferior nasal concha

Cerebellum

Medulla oblongata

Nasopharynx

Spinal cord

Tongue

Median

Transnasal 1990s–present

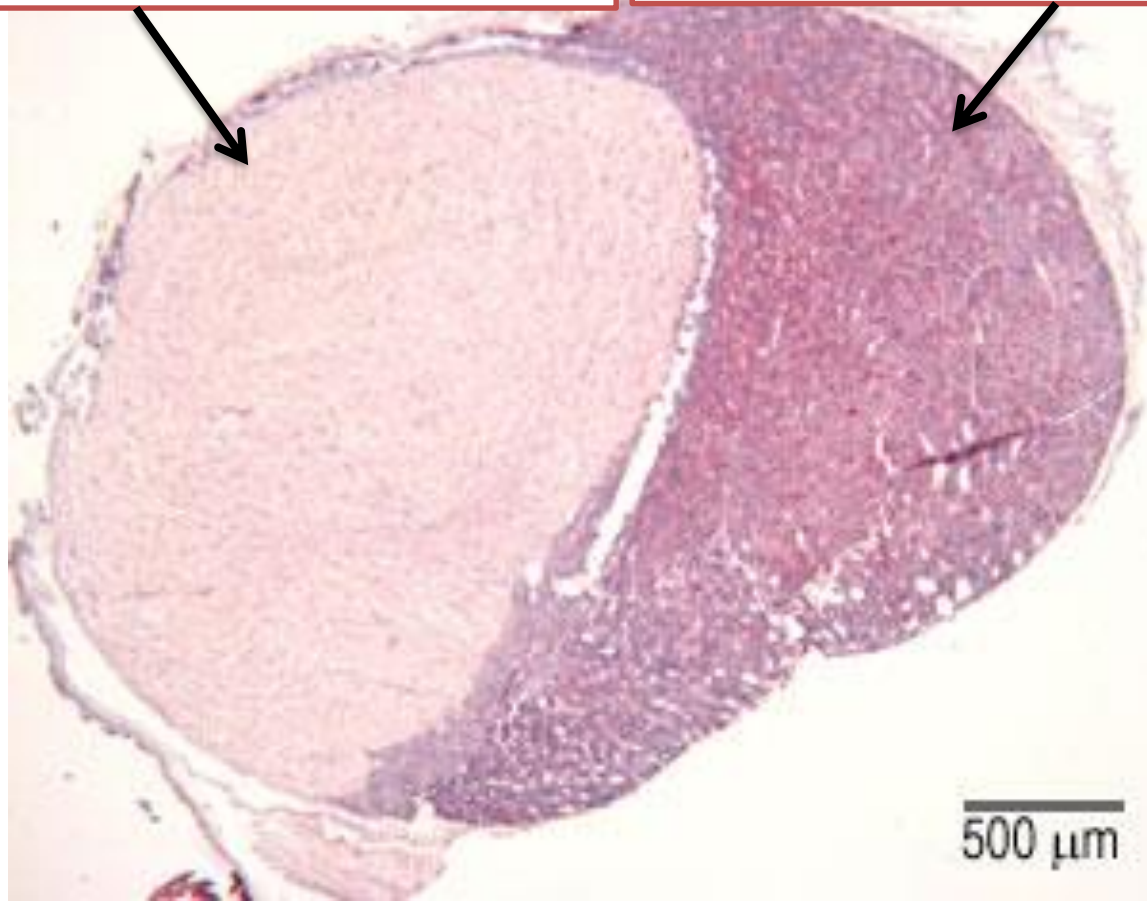
Surgical approach



The pituitary gland is composed of
two functional tissues

Neural (secretory) tissue
Posterior lobe
(**Neurohypophysis**)

Glandular epithelial tissue
The Anterior lobe
(**Adenohypophysis**)



500 μm

Embryology

Important

**Each endocrine gland has
two different
Embryological origins**



The two portions are of different embryologic origin

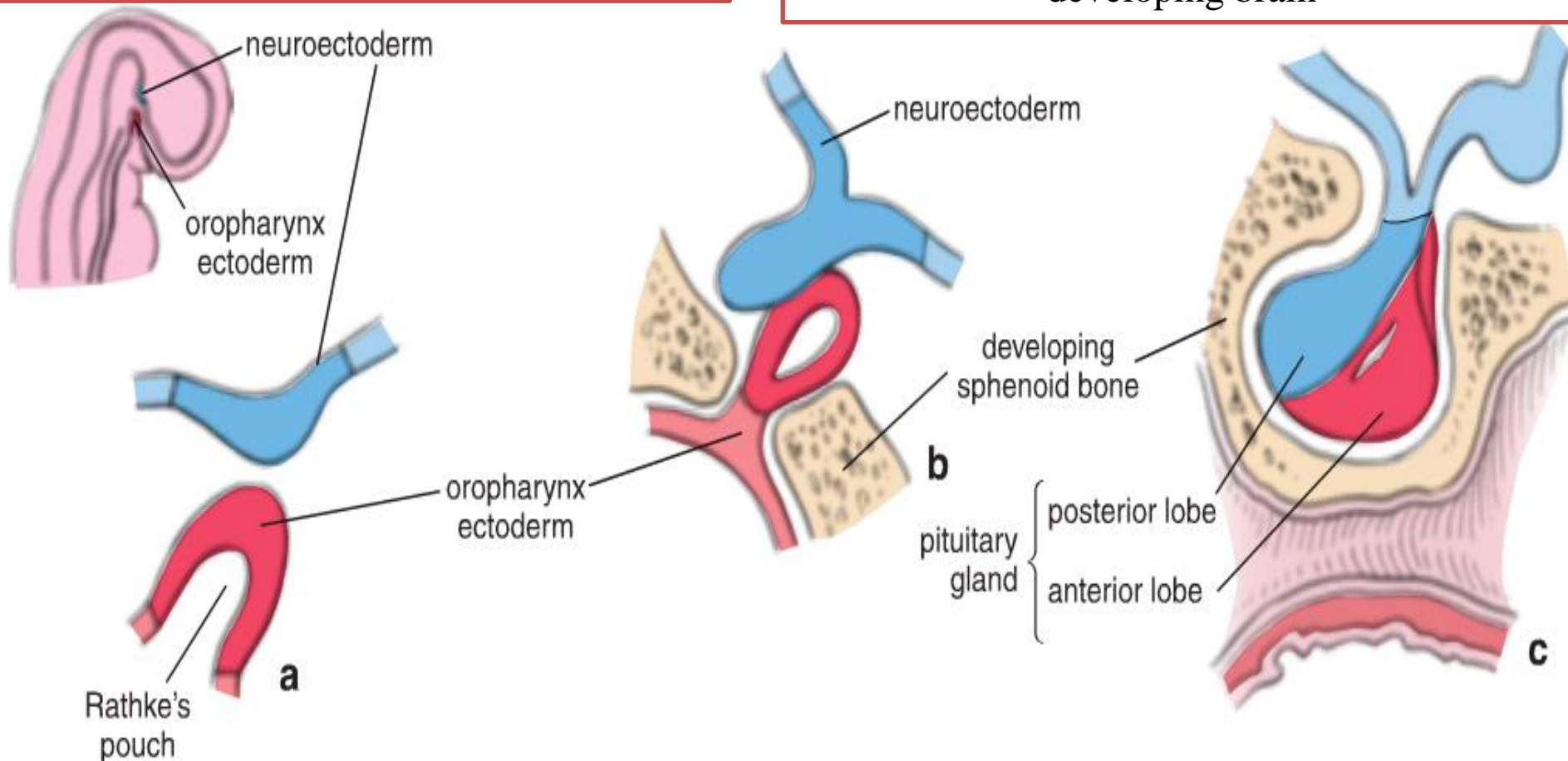
The anterior lobe of the pituitary gland is derived from an evagination of the ectoderm of the oropharynx

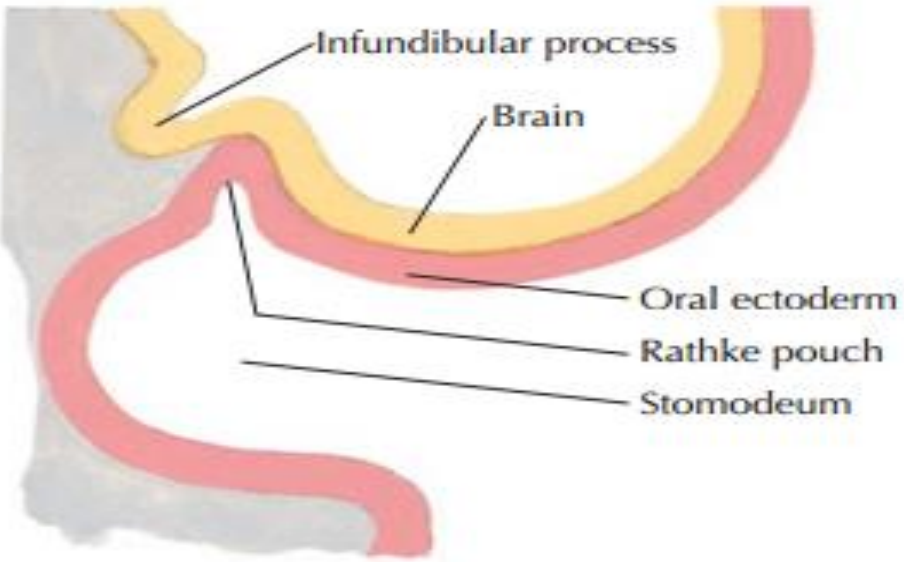
toward the brain

Rathke's pouch

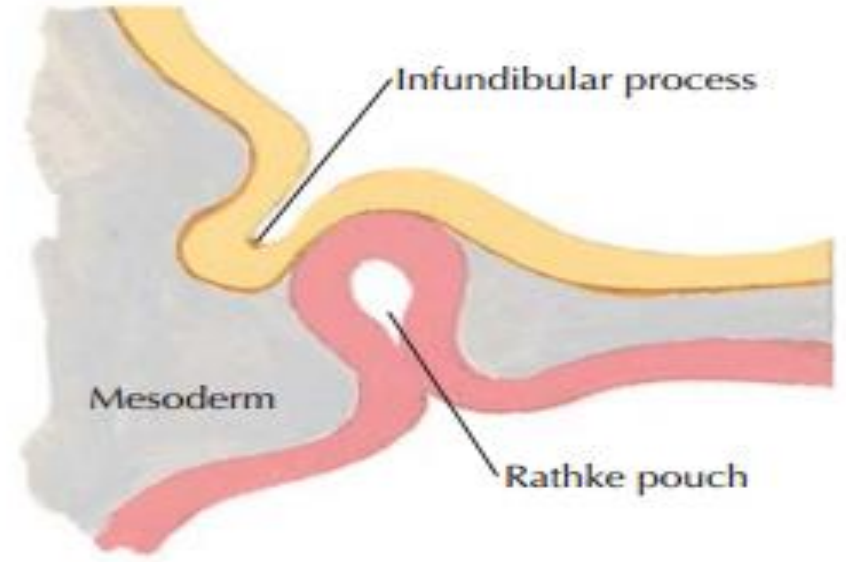
The posterior lobe of the pituitary is derived from a downgrowth (the future infundibulum)

neuroectoderm of the floor of the third ventricle (the diencephalon) of the developing brain

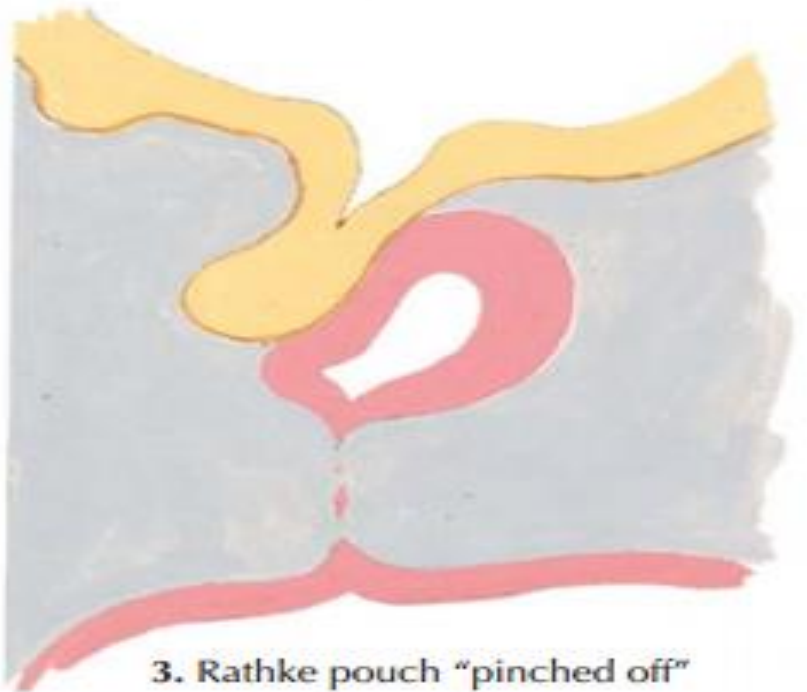




1. Beginning formation of Rathke pouch and infundibular process



2. Neck of Rathke pouch constricted by growth of mesoderm



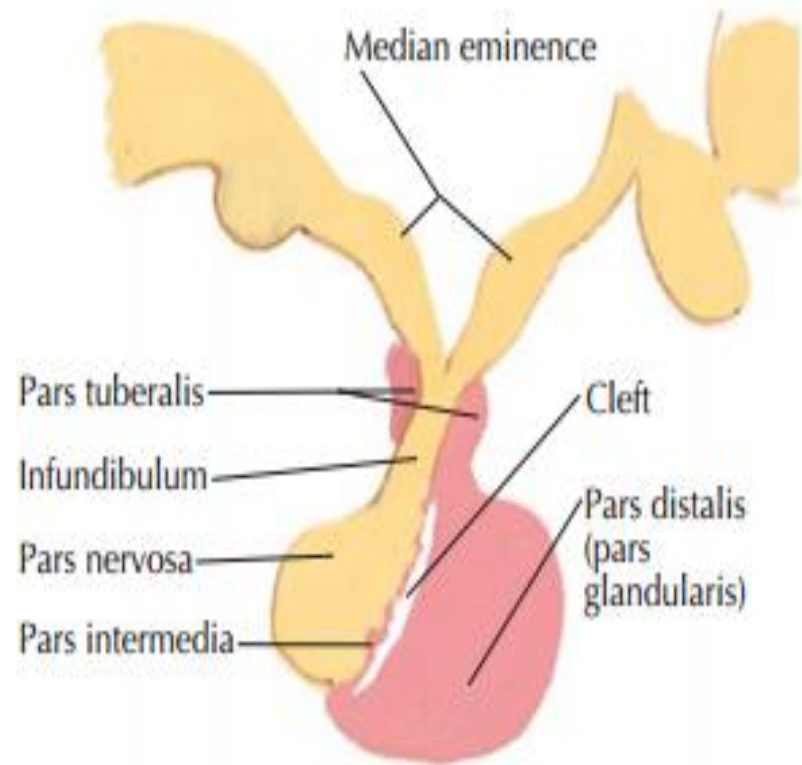
3. Rathke pouch "pinched off"



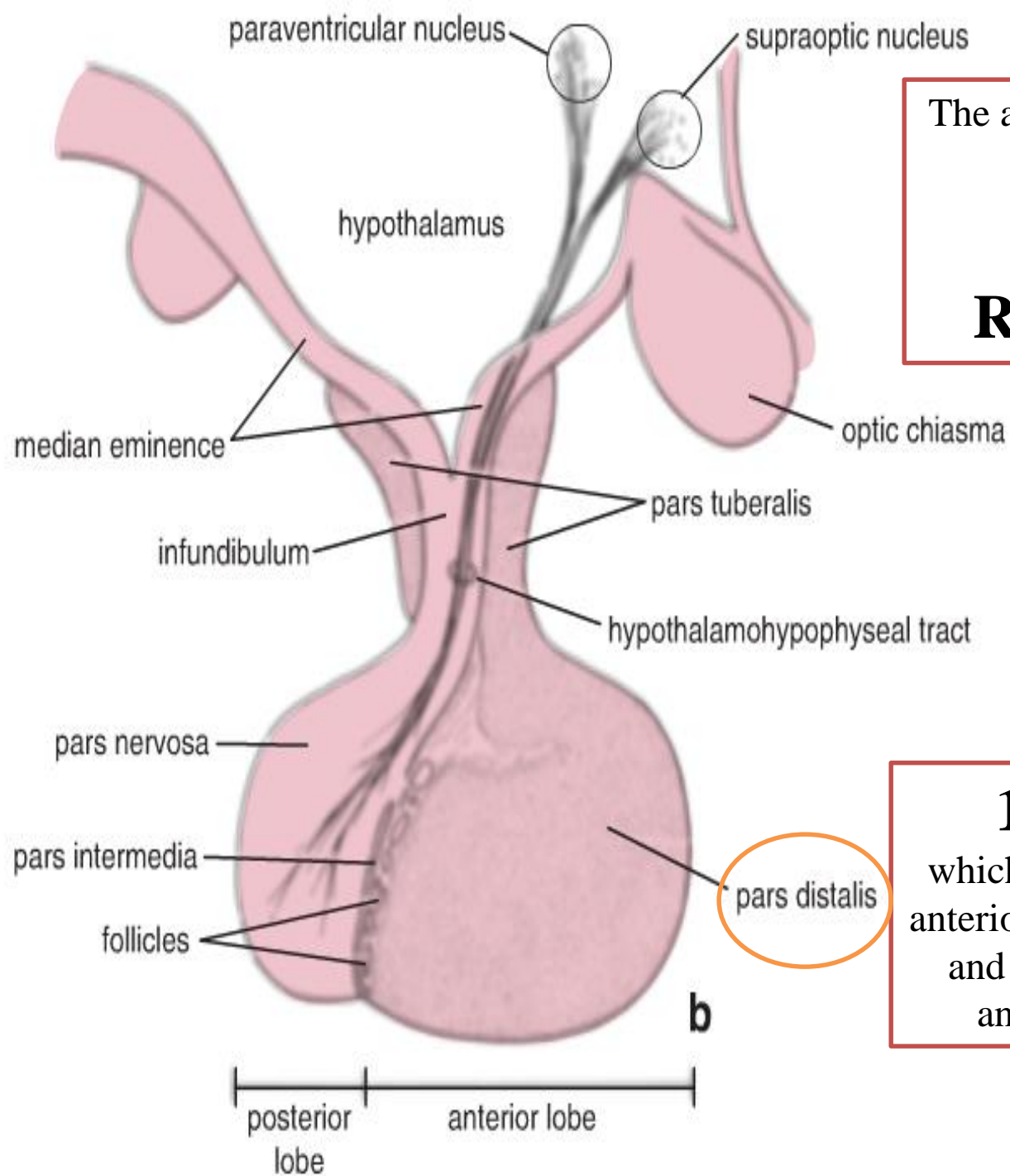
4. "Pinched off" segment conforms to neural process, forming pars distalis, pars intermedia, and pars tuberalis



5. Pars tuberalis encircles infundibular stalk (lateral surface view)



6. Mature form



The anterior lobe of the pituitary gland consists of three derivatives of

Rathke's pouch:

1-Pars distalis which comprises the bulk of the anterior lobe of the pituitary gland and arises from the thickened anterior wall of the pouch

paraventricular nucleus supraoptic nucleus

It is **not part** of the pituitary gland

The **median eminence** is part of the **hypothalamus** from which regulatory hormones are released

median eminence

pars tuberalis

3-Pars tuberalis
which develops from the thickened lateral walls of the pouch and forms a sheath around **the infundibulum**

2-Pars intermedia
a thin remnant of the posterior wall of the pouch

pars intermedia

pars nervosa

follicles

hypothalamohypophyseal

optic chiasma

hypothalamus

infundibulum

pars distalis

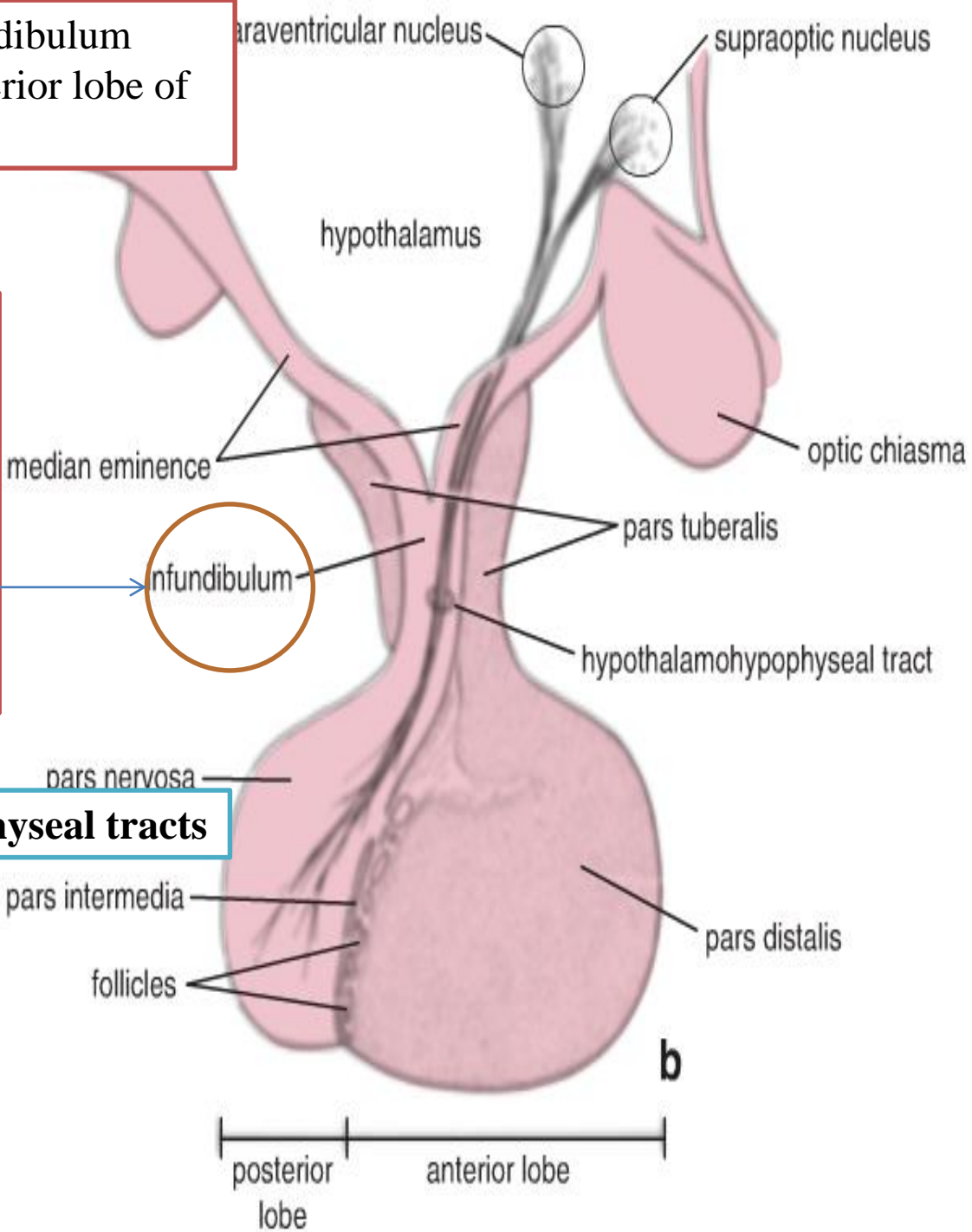
b



The embryonic infundibulum gives rise to the posterior lobe of the pituitary gland

Infundibulum, which is continuous with the median eminence and contains the **neurosecretory axons forming the**

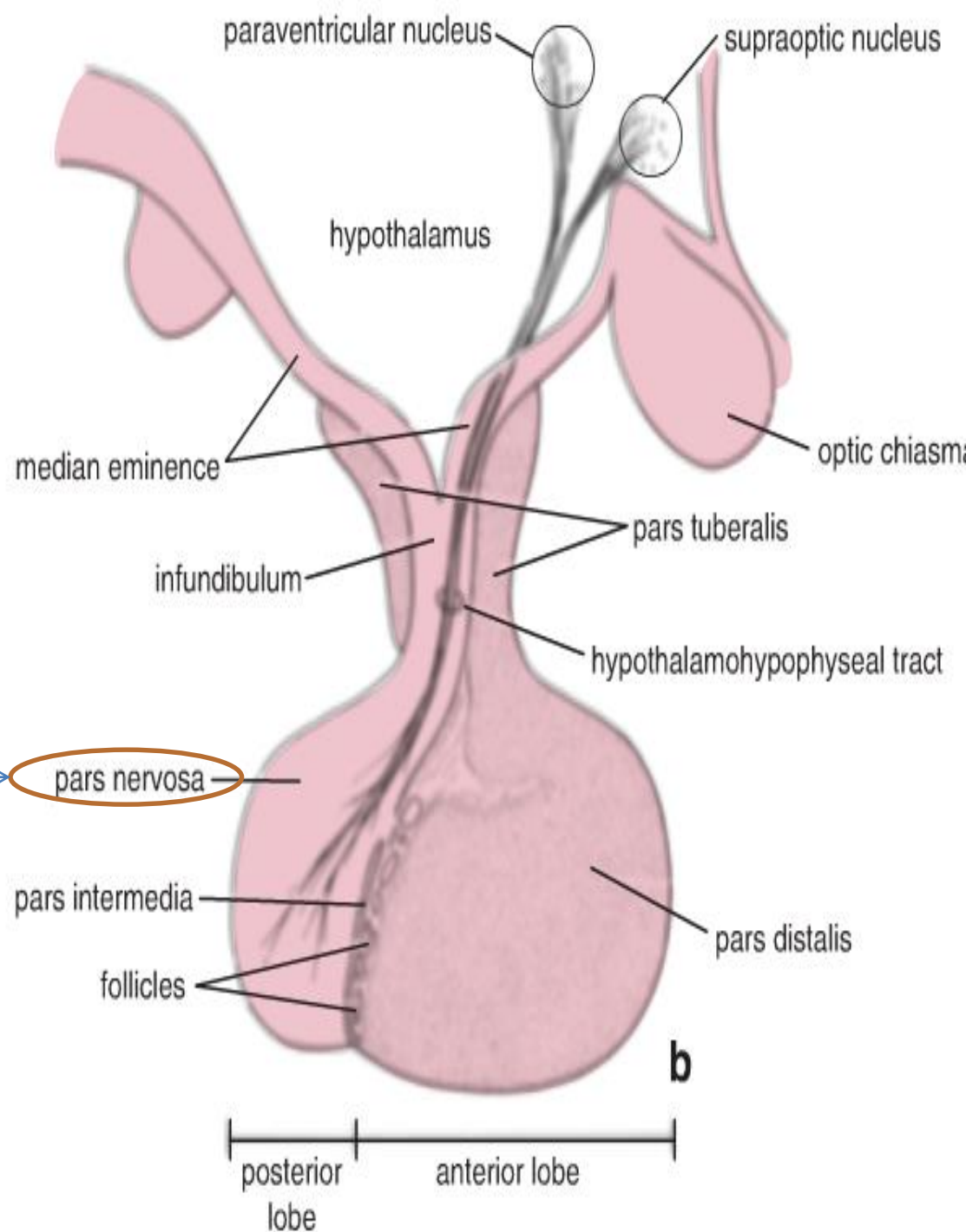
hypothalamohypophyseal tracts

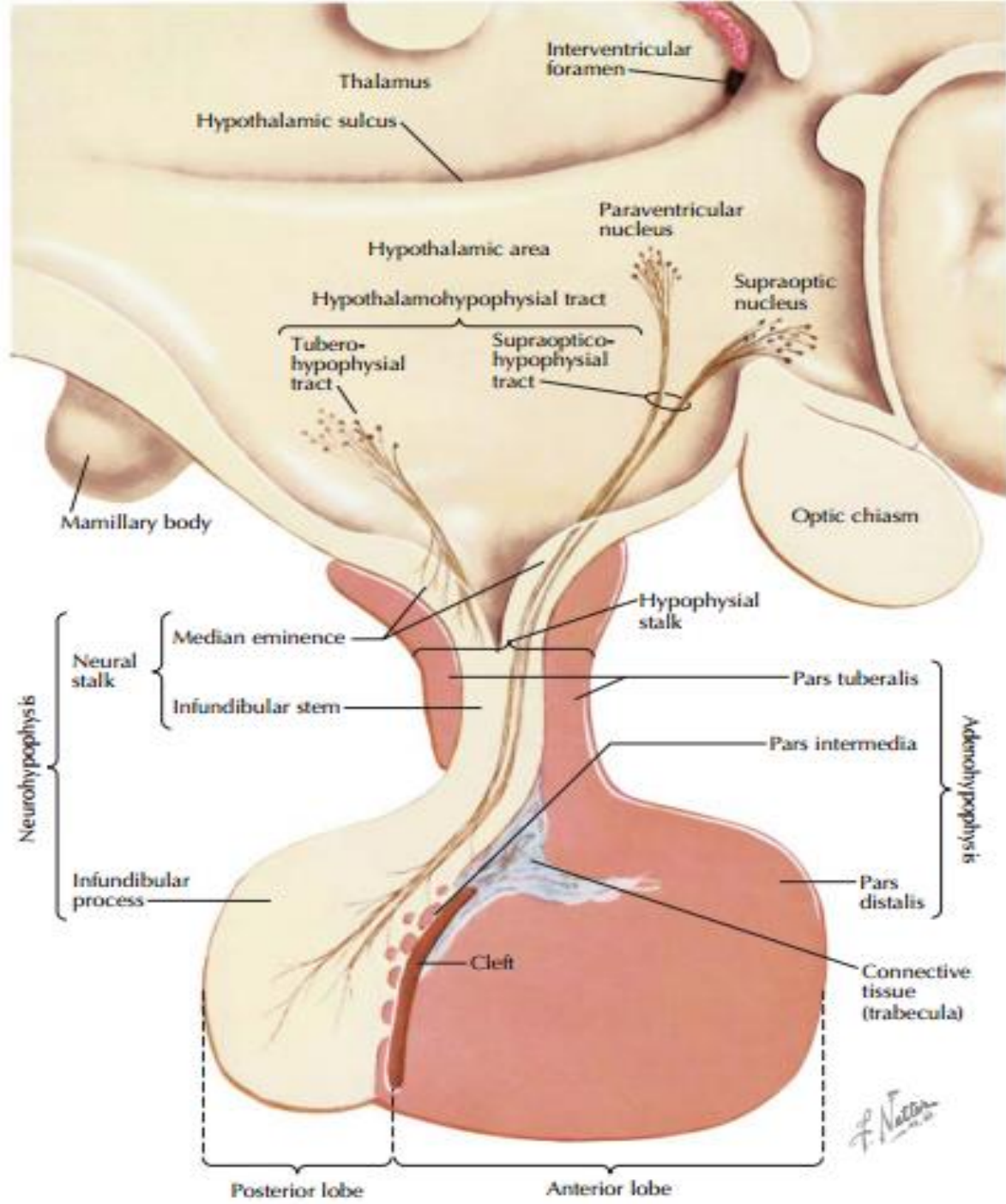


The posterior lobe

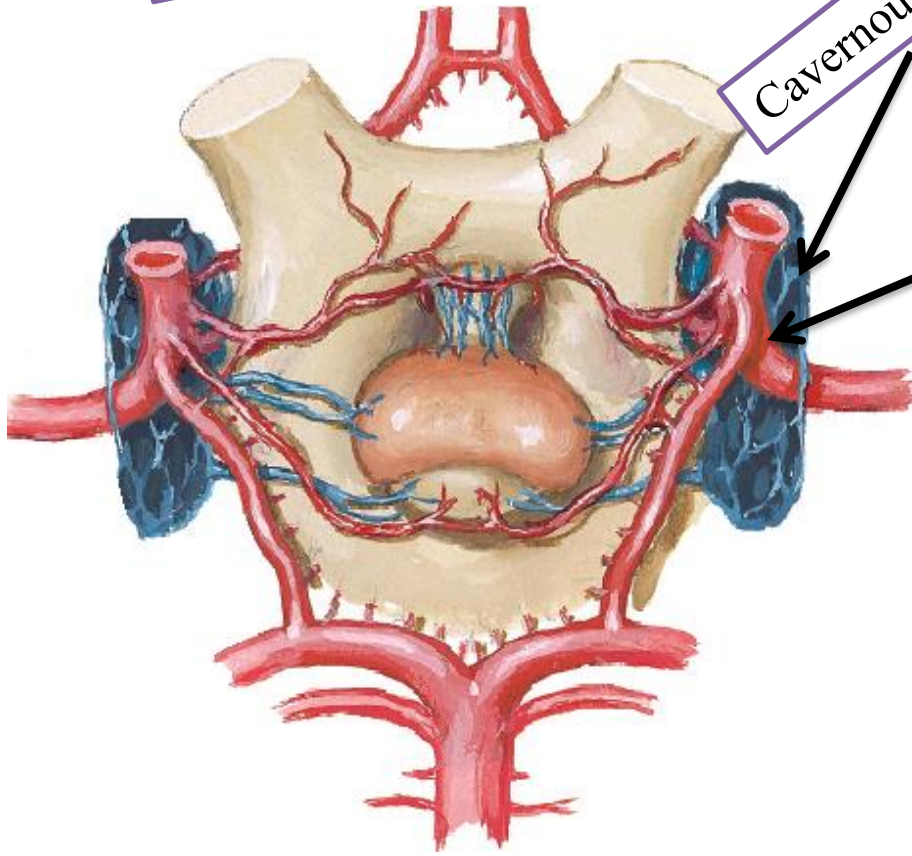
consists of the following:

- **Pars nervosa**, which contains neurosecretory axons and their endings





Blood supply



Cavernous sinus

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

The inferior branch supplies the posterior lobe of the pituitary gland

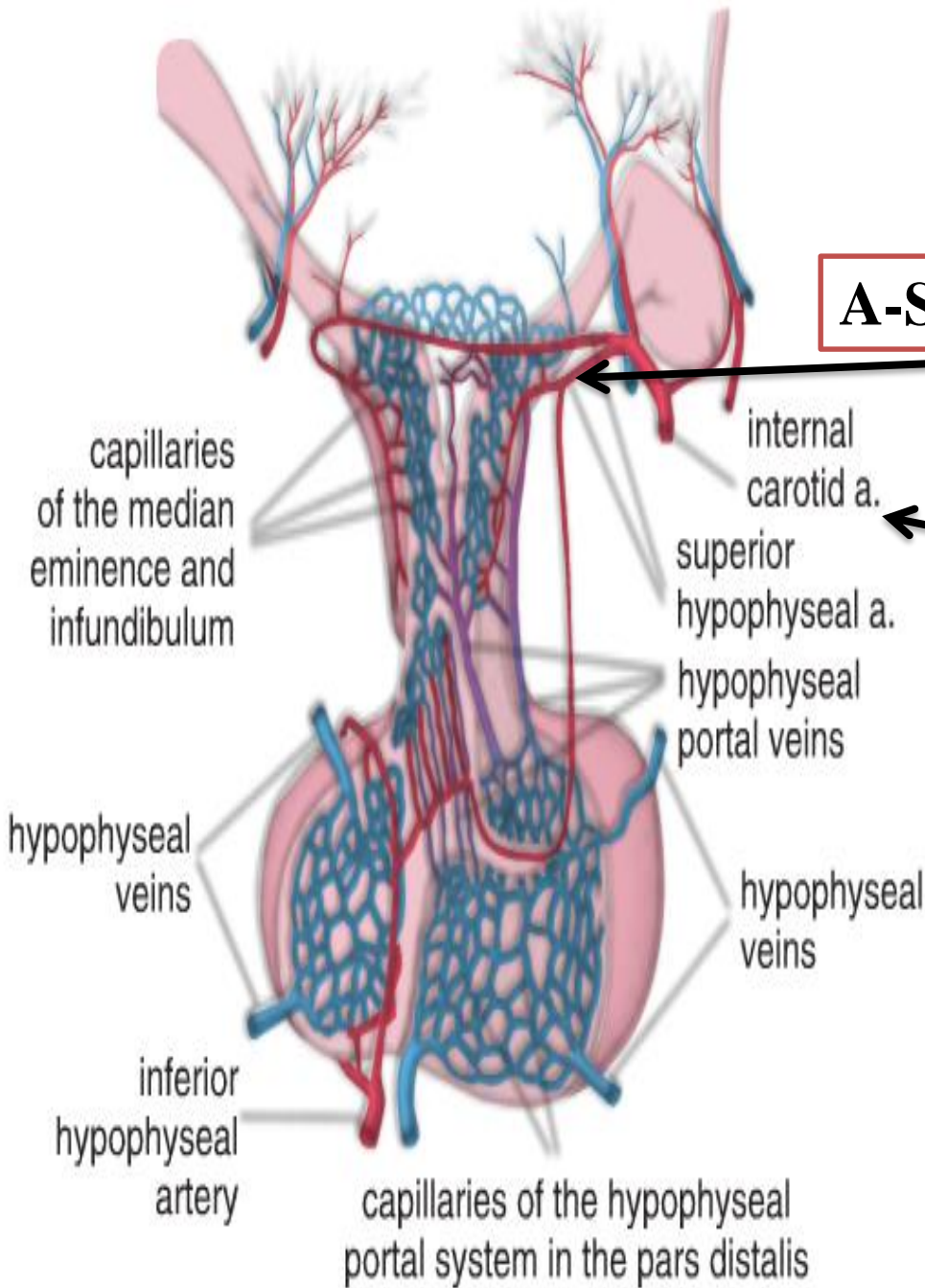
The superior branch leads into the median eminence to start the hypophysial portal system to the anterior lobe

Blood supply

A-Superior hypophyseal arteries

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

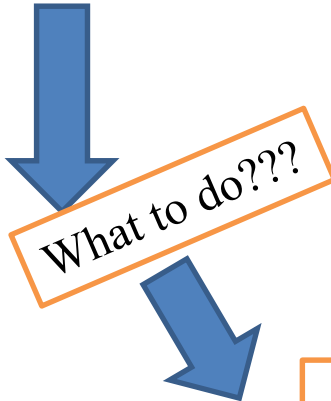
They supply
The pars tuberalis
Median eminence
Infundibulum



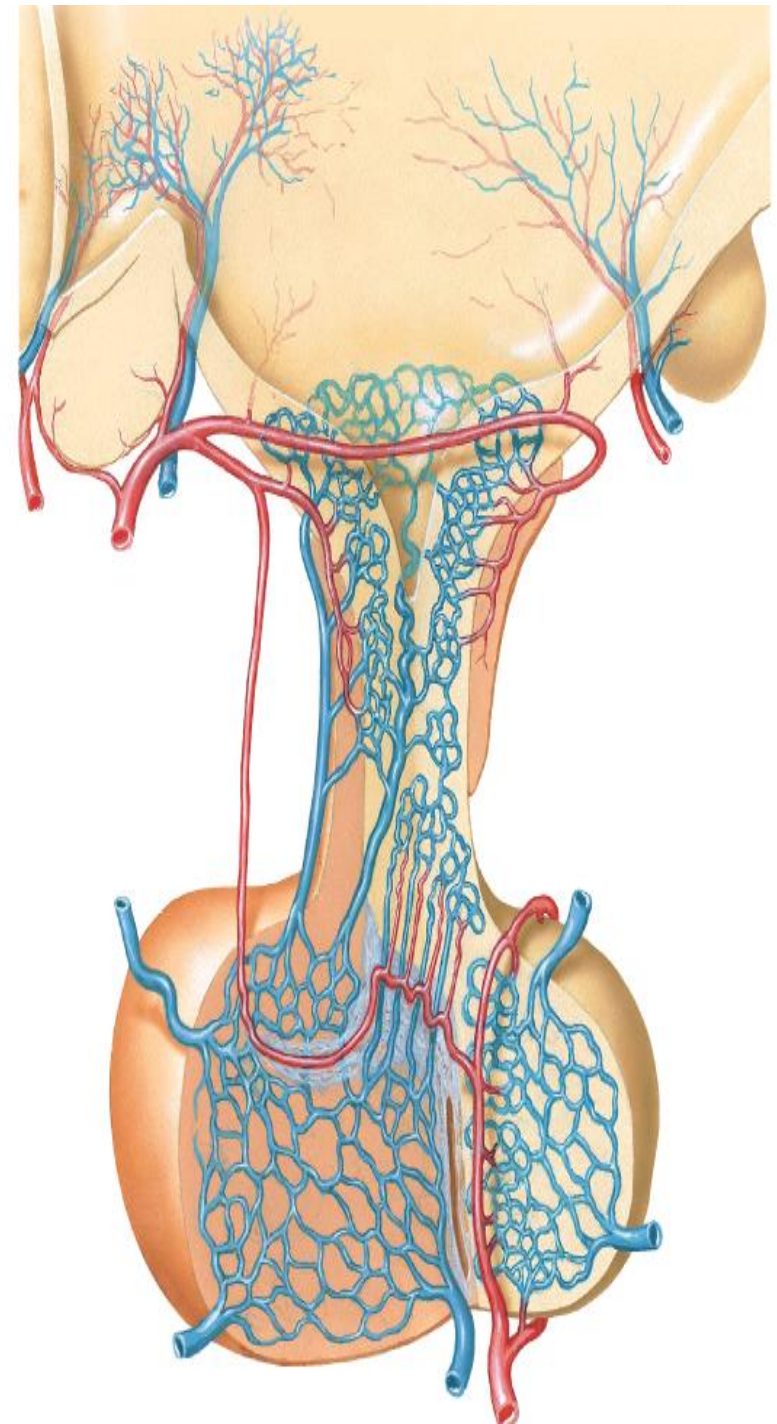
Divides into medial and lateral arteries

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!!!!**



A Portal System

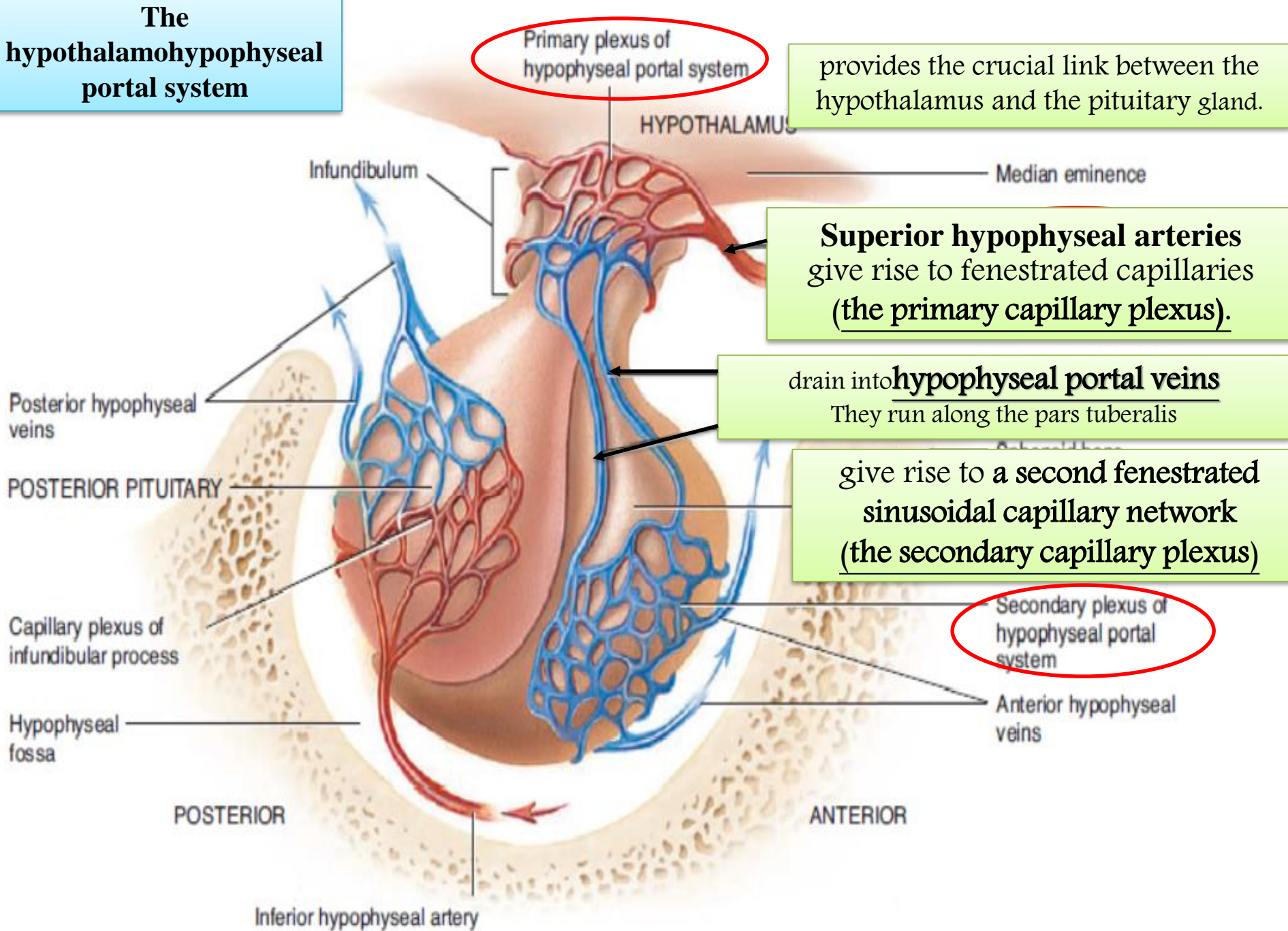


WHAT IS A Portal System?

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.

The hypothalamohypophyseal portal system



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

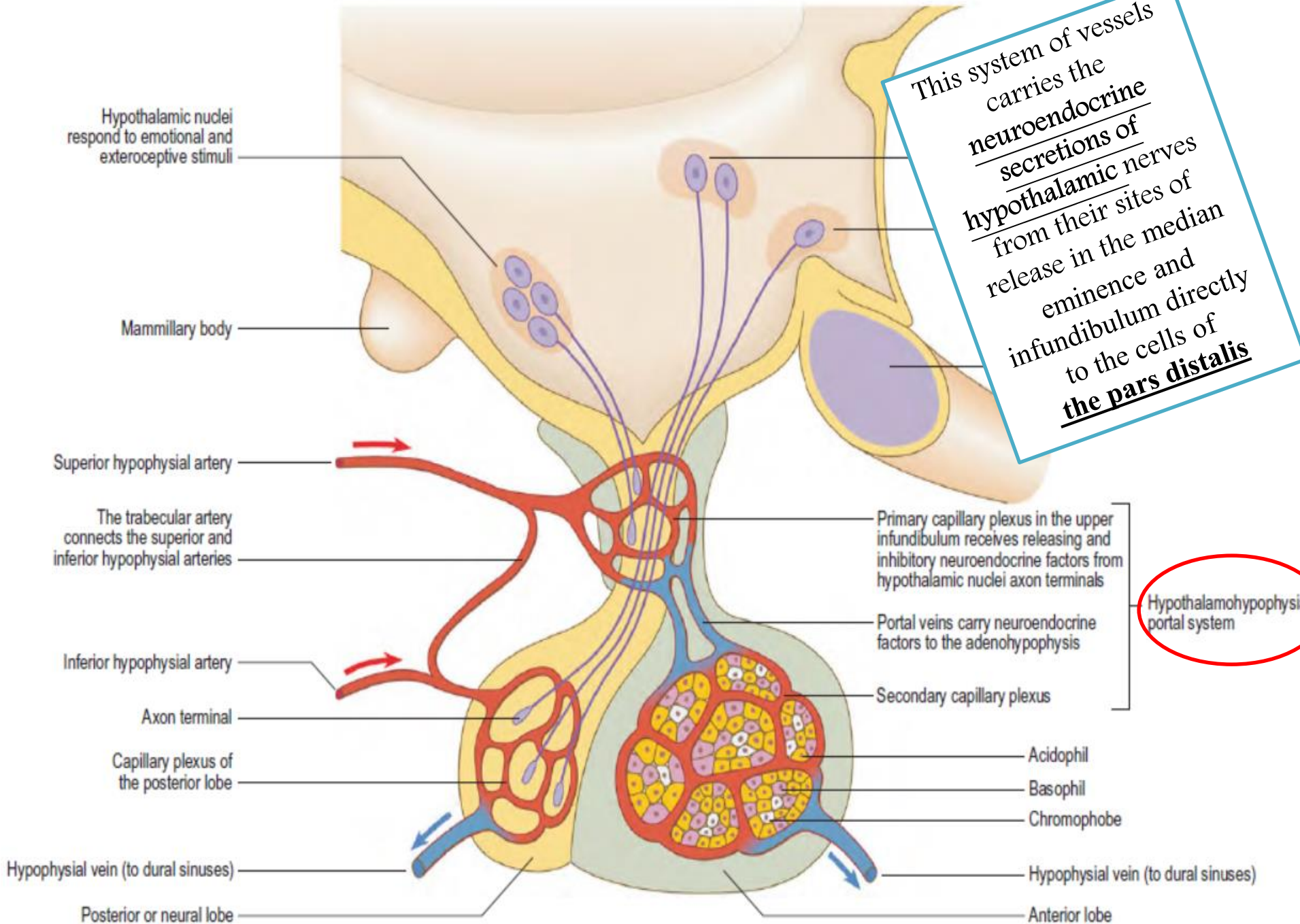
Superior hypophyseal arteries give rise to fenestrated capillaries (the primary capillary plexus).

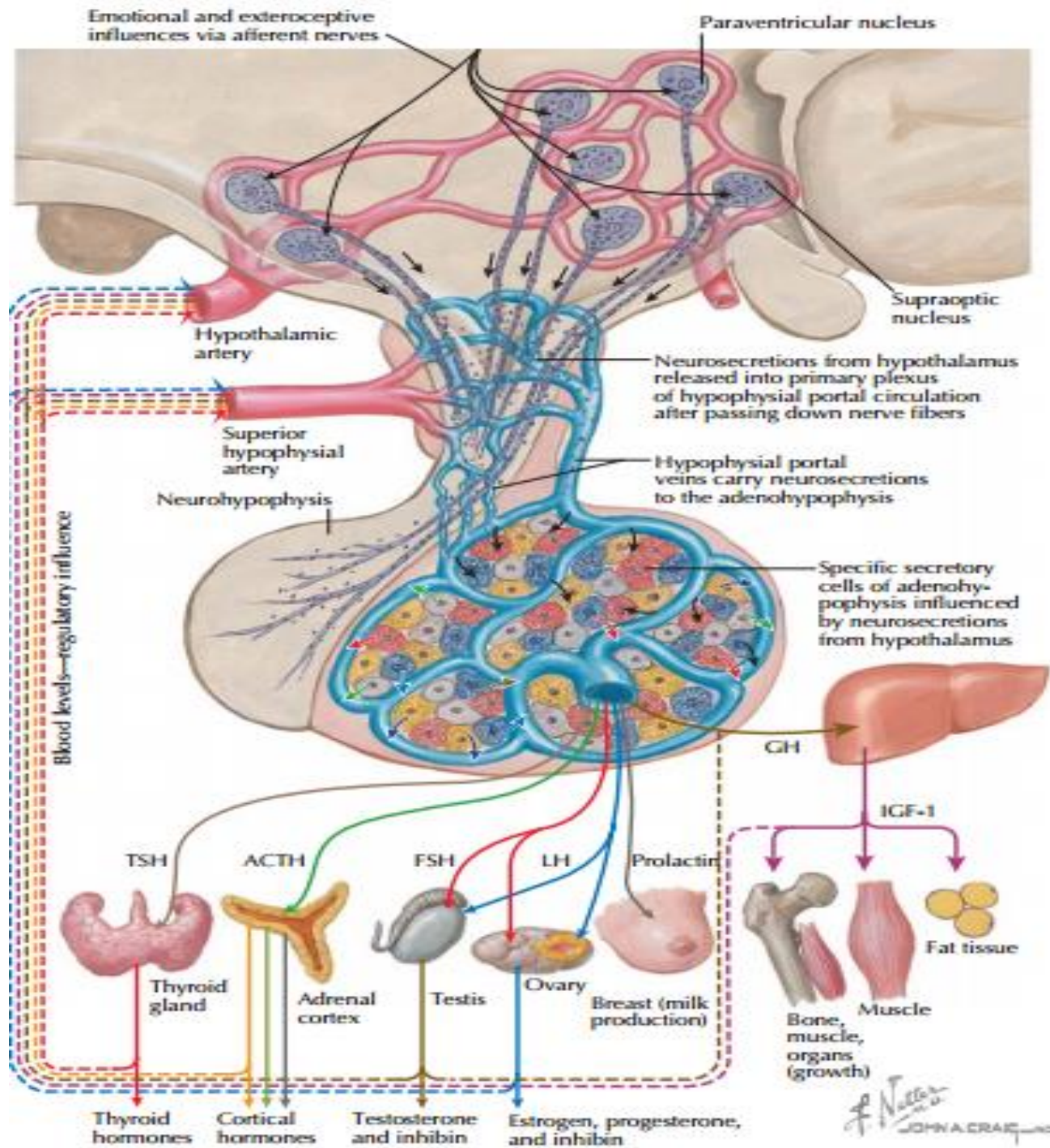
drain into hypophyseal portal veins
They run along the pars tuberalis

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

Secondary plexus of hypophyseal portal system

(a) Relationship of hypothalamus to pituitary gland



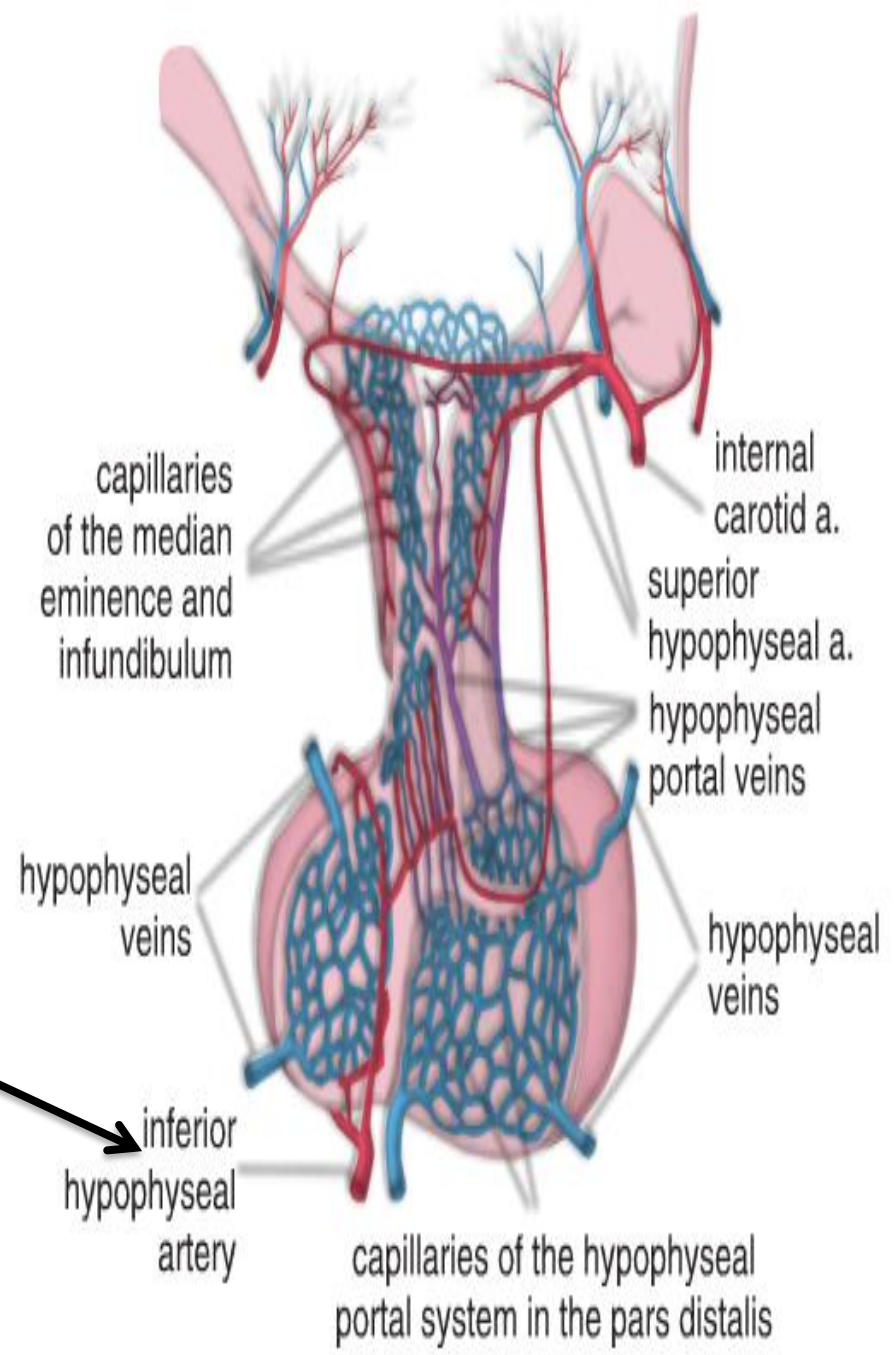


B-Inferior hypophyseal arteries

The inferior hypophysial vessels arise solely from the internal carotid arteries

primarily supply the pars nervosa

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.**

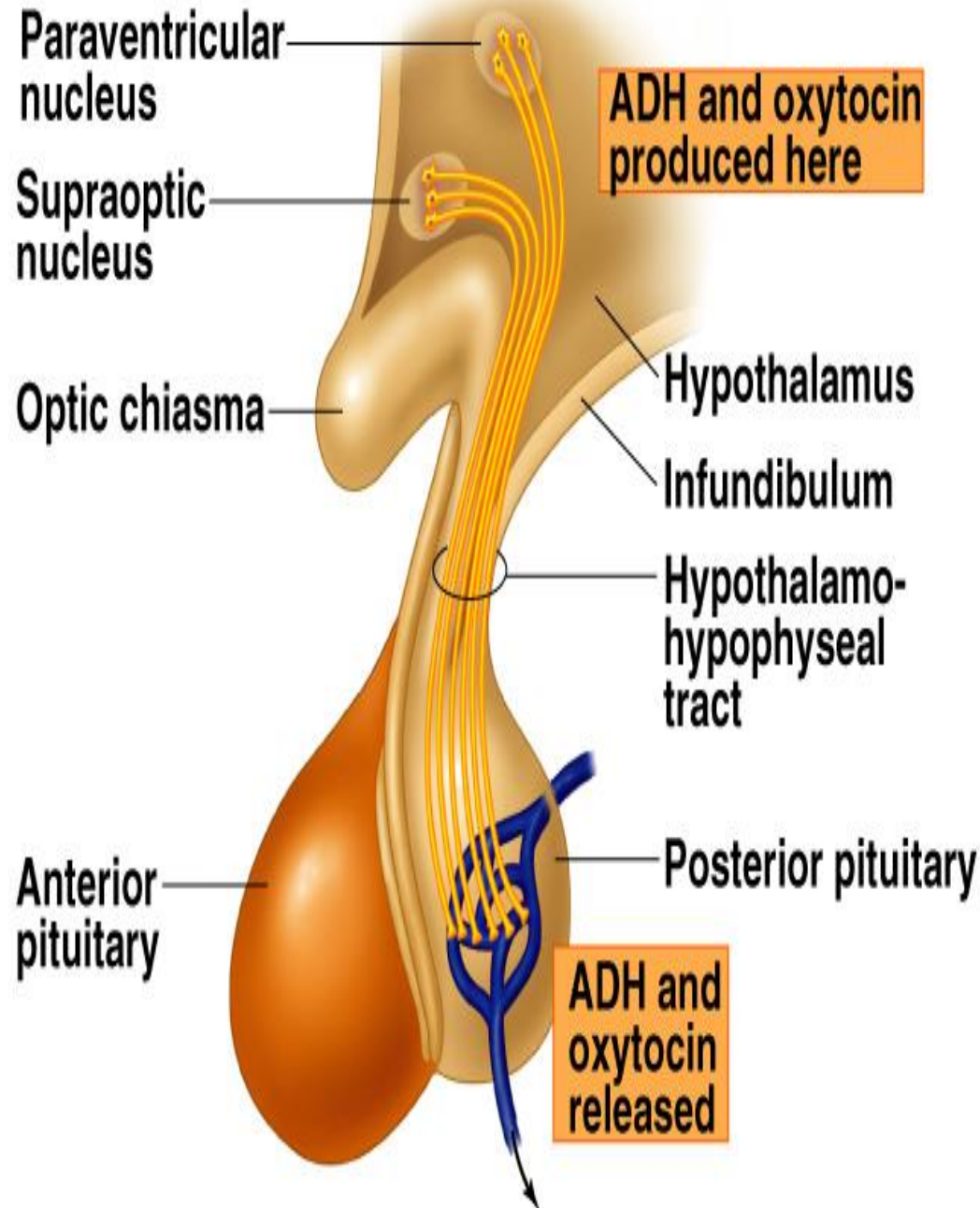
These short pathways provide a route by which the hormones of the anterior lobe of the pituitary gland could provide **feed back** directly to the brain without making the full circuit of the systemic circulation.

The posterior pituitary

Permission required for reproduction or display.

Neurohypophysis

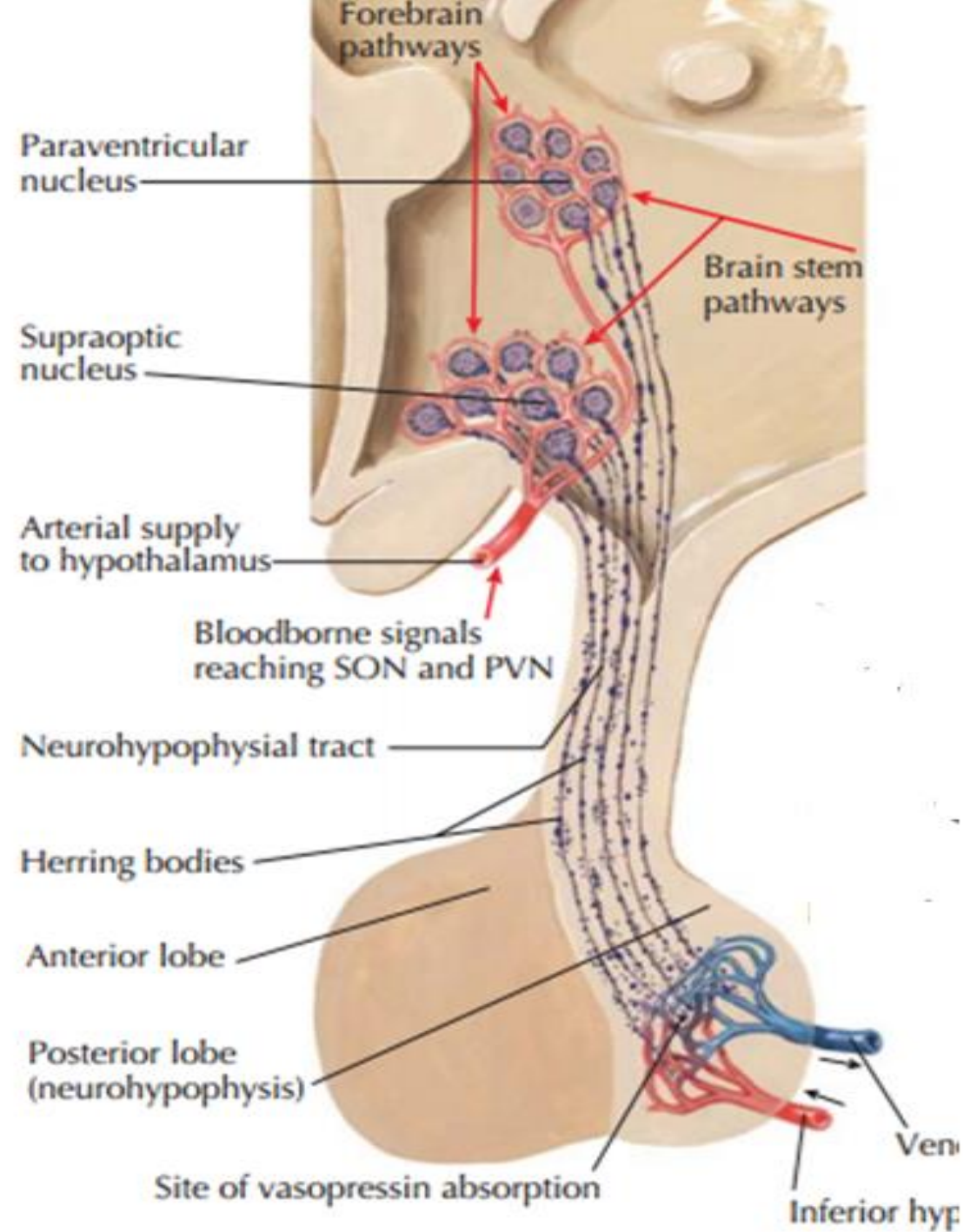
is neural tissue and is formed by the distal axons of The supraoptic nucleus (SON) and The paraventricular nucleus (PVN) of the hypothalamus.



The axon terminals store neurosecretory granules that contain vasopressin

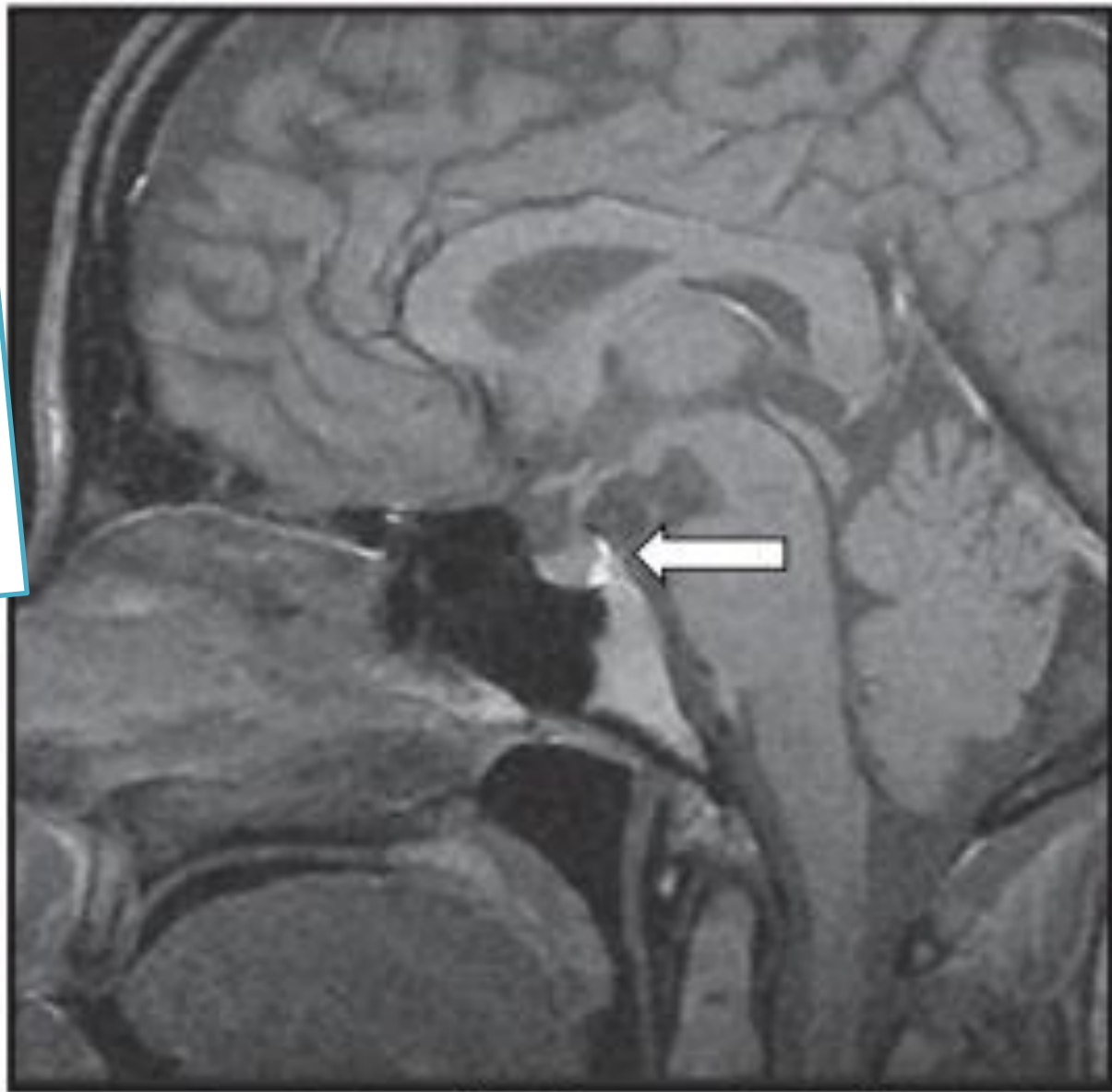
The blood supply for the posterior pituitary is from the inferior hypophysial arteries

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.”**

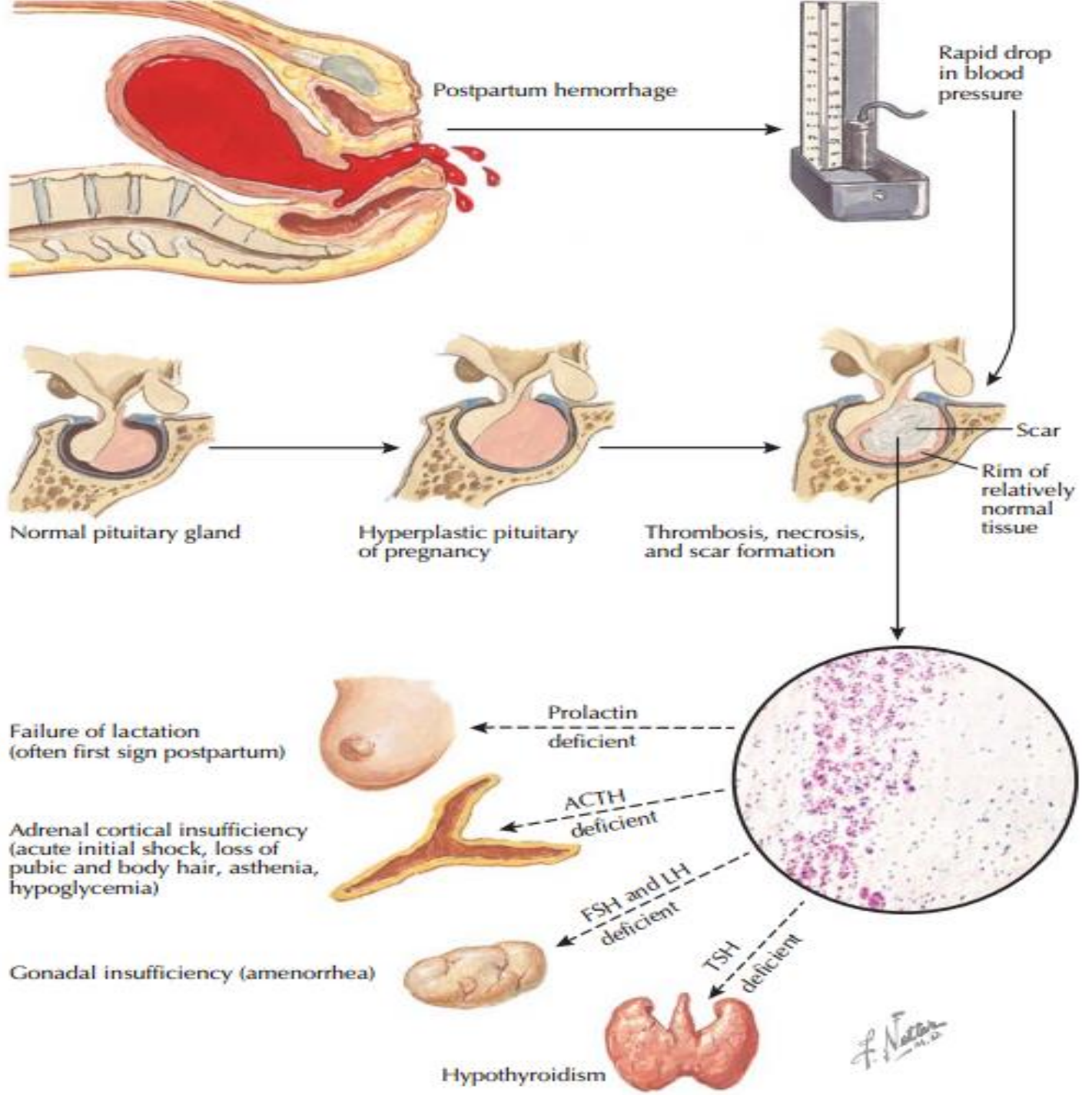
The posterior pituitary bright spot is present in most healthy individuals and is absent in individuals with central diabetes insipidus.



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

Clinical applications

(SHEEHAN SYNDROME)



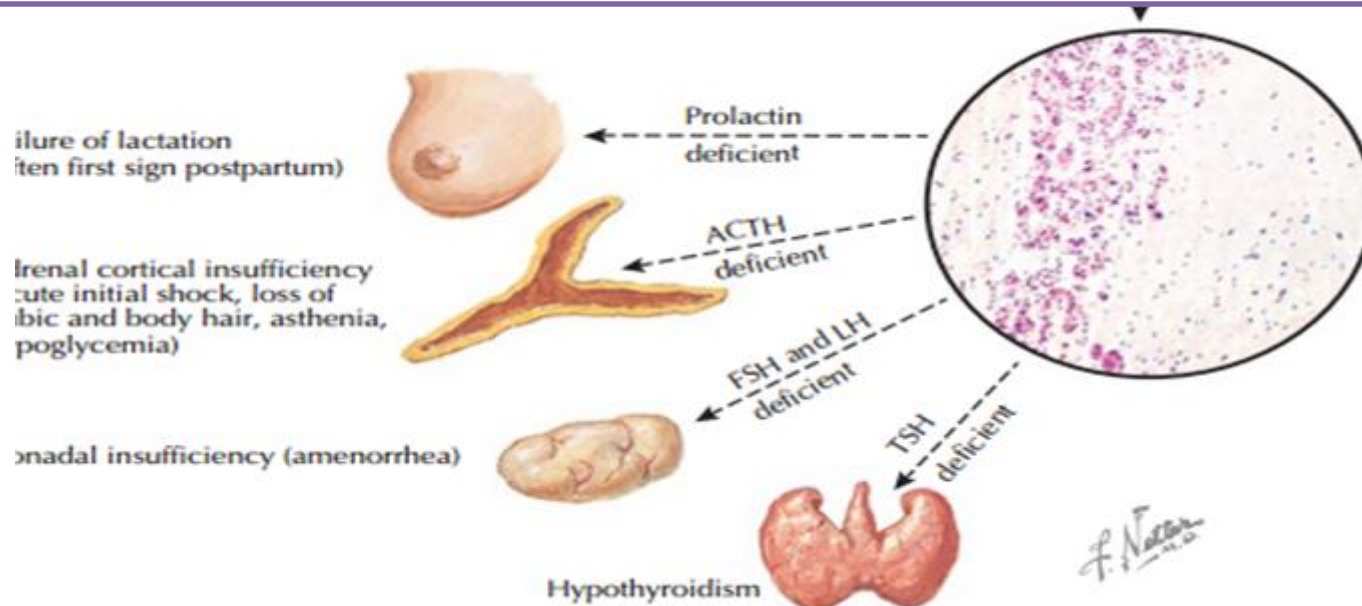
The pituitary gland enlarges during pregnancy (primarily because of lactotroph hyperplasia)

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



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

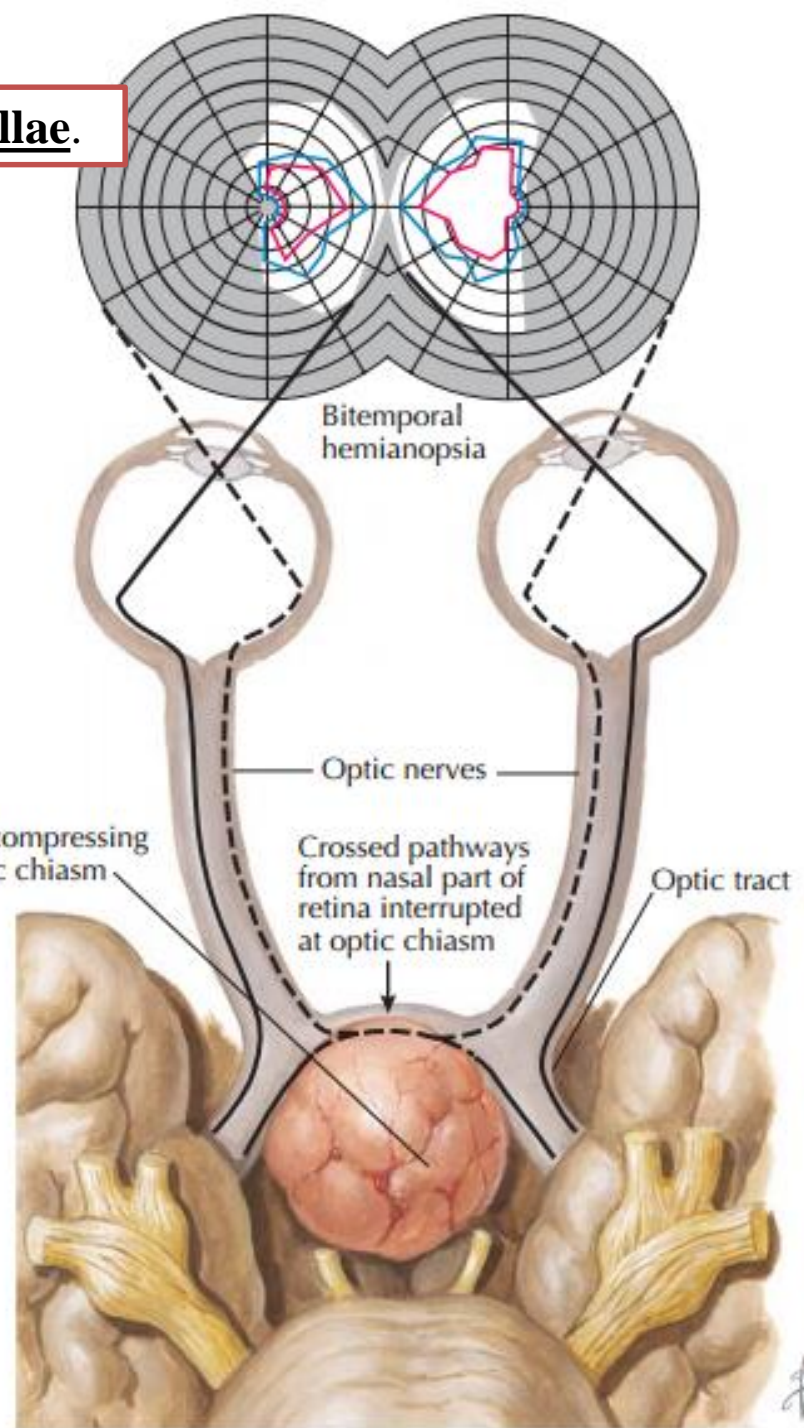


is a visual defect caused by the growth pressing on the optic chiasm..

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 tumor compressing or invading optic chiasm



Bitemporal hemianopsia

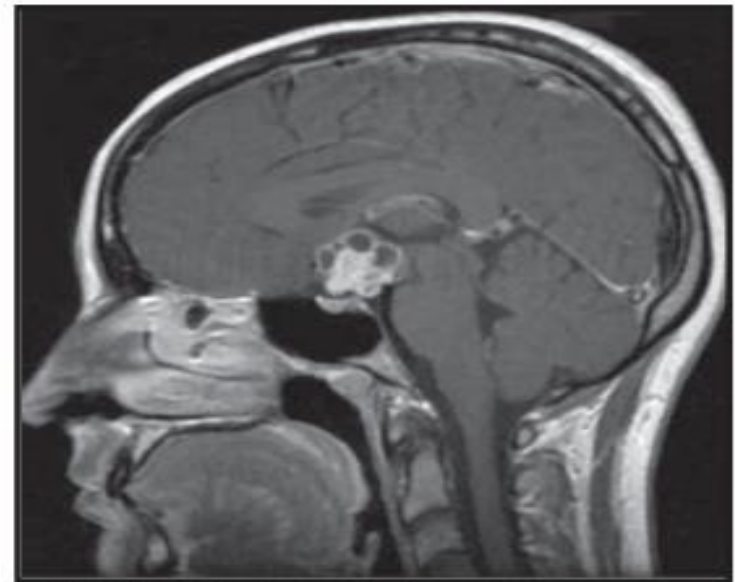
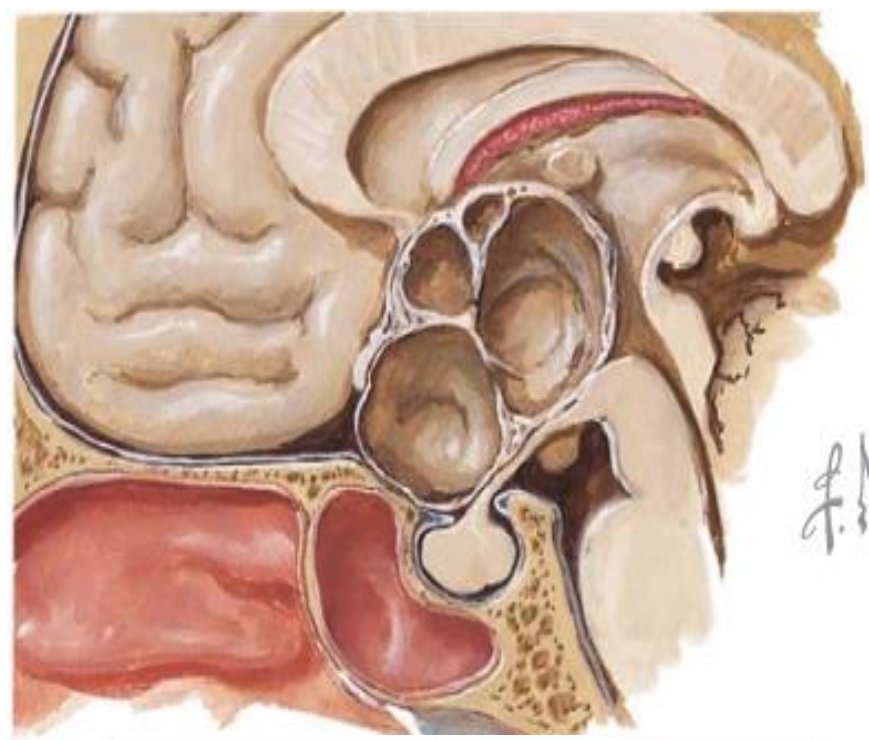


A city as seen with bitemporal hemianopsia.

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 craniopharyngioma



Suprasellar



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



Intrasellar anterior lobe



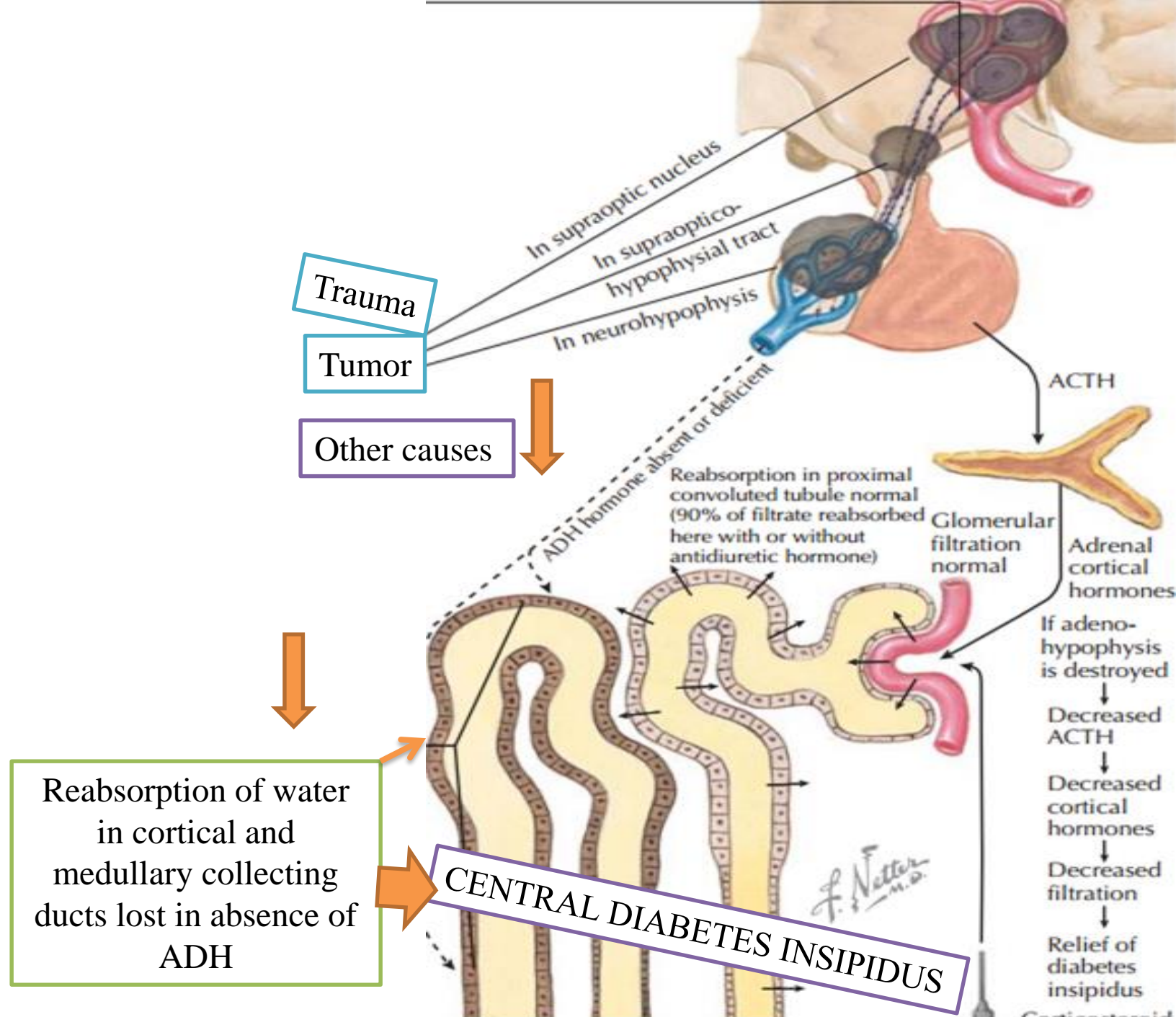
Anterior lobe hypofunction of variable degree



Intrasellar posterior lobe



Diabetes insipidus



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**

