ENDOCRINE SYSTEM

Department of Histology, Cytology and Embryology
of the General Medicine Faculty
Pirogov Russian National Research Medical University

STRUCTURES OF THE ENDOCRINE SYSTEM

***Central endocrine glands*:**

•neurosecretory hypothalamic nuclei

•pituitary gland (hypophysis)

•pineal gland (epiphysis cerebri)

***Peripheral endocrine glands*:**

-*Adenohypophysis-dependent formations*:

•thyroid gland (follicular endocrine cells)

•adrenal cortex

-*Adenohypophysis-independent formations*:

•parathyroid glands

•adrenal medulla

•C-cells of the thyroid

Endocrine portions of non-endocrine organs:

•pancreatic islets of Langerhans (*hypophysis-independent*)

•endocrine portions of the testes and the ovaries (*hypophysis-dependent*)

•endocrine cells of the placenta (*hypophysis-dependent*)

Hormone-producing cells of the diffuse endocrine system:

cells of the APUD-system

cells of the gastroenteropancreatic endocrine system

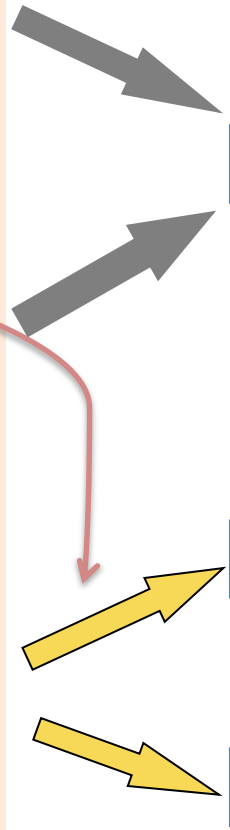
Chemical nature of hormones *corresponds to* **localization of their receptors:**

•*Proteins*
prolactin, somatotropin, thyrotropin, gonadotropins
Peptides
insulin, glucagon, parathyrin, calcitonin, oxytocin, vasopressin, gastrin, secretin, endorphins, enkephalins, kinins etc.

•*Amines and aminoacid derivatives*
thyroxine (exception!), melatonin etc.

Neurotransmitters and neuromodulators
acetylcholine, norepinephrine, dopamine, glutamate etc.

•*Steroids* (*cholesterol derivatives*)
aldosterone, cortisol, sex hormones, calcitriol (vitamin D3)
Related lipid-soluble compounds
arachidonic acid and the related polyunsaturated fatty acid derivatives – eikosanoids (prostaglandins, prostacyclins etc.)



CELL SURFACE RECEPTORS

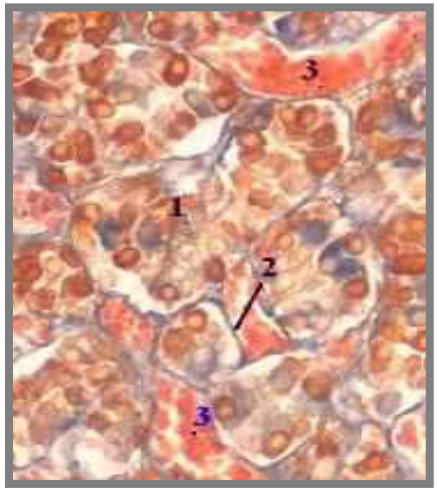
CYTOPLASMIC RECEPTORS

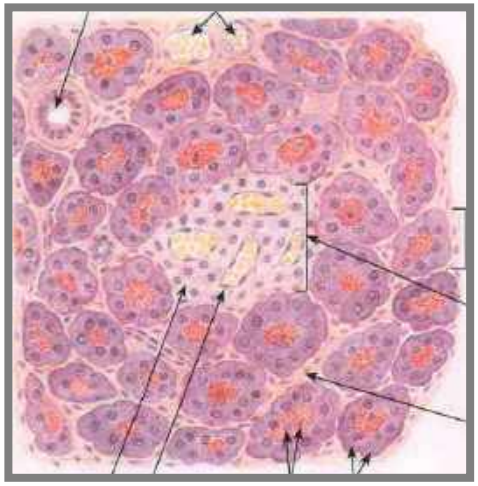
NUCLEAR RECEPTORS

STRUCTURAL FEATURES OF THE ENDOCRINE ORGANS

PARENCHYMA

- follicles
- epithelial cords
- clusters of endocrine cells



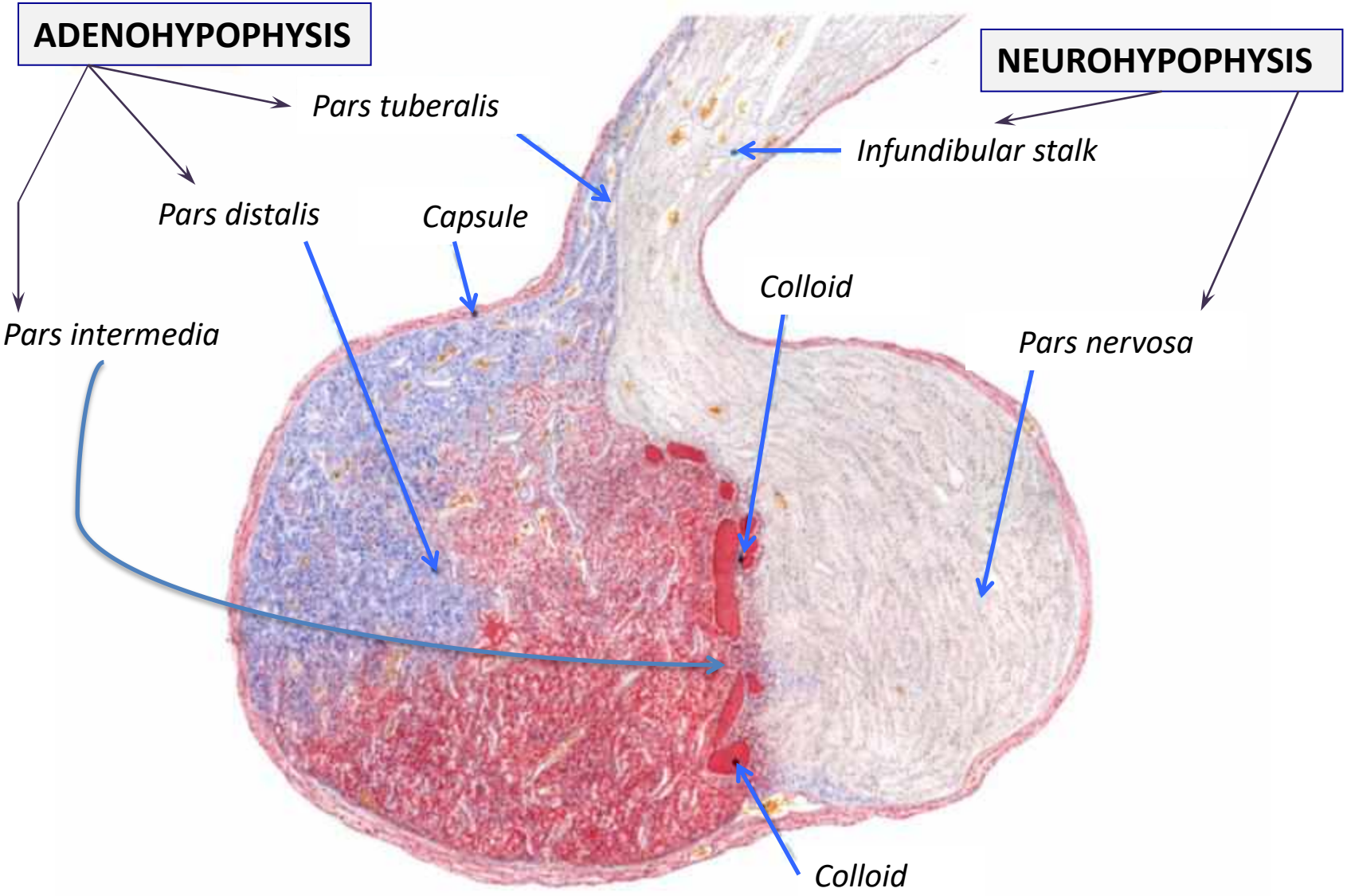


STROMA

- capsule
- connective tissue trabeculae that separate an organ into lobules
- LCT
- fenestrated blood capillaries

Excretory ducts are absent

HYPOPHYSIS (pituitary gland)



PITUITARY GLAND DEVELOPMENT

ECTODERM OF THE ORAL PIT

↓

EPITHELIAL RATHKE'S POUCH

WALLS — **CAVITY**

↓ WALLS → **ADENOHYPOPHYSIS**

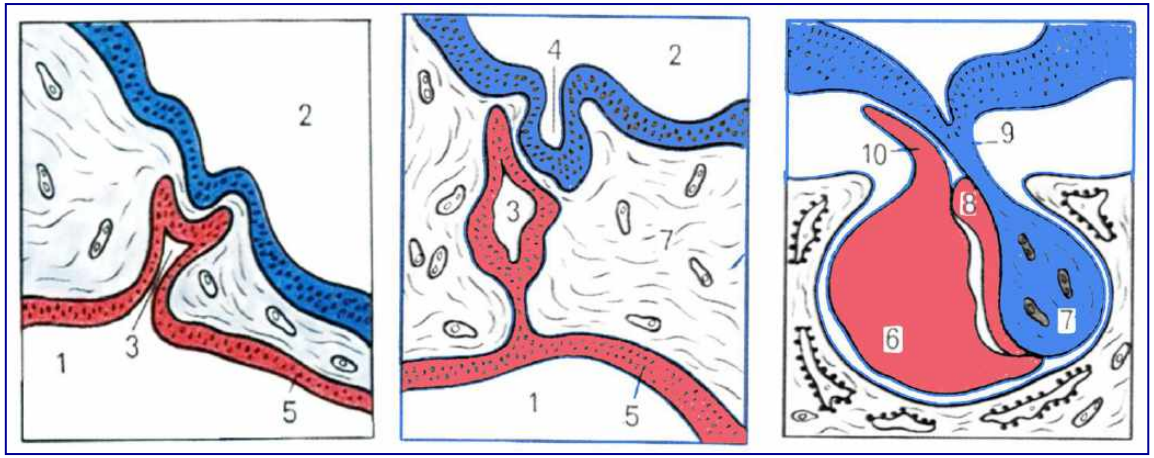
CAVITY → **HYPOPHYSEAL CLEFT**

ADENOHYPOPHYSIS →
- **PARS TUBERALIS**
- **PARS DISTALIS**
- **PARS INTERMEDIA**

DIENCEPHALIC PORTION OF THE EMBRYONIC BRAIN

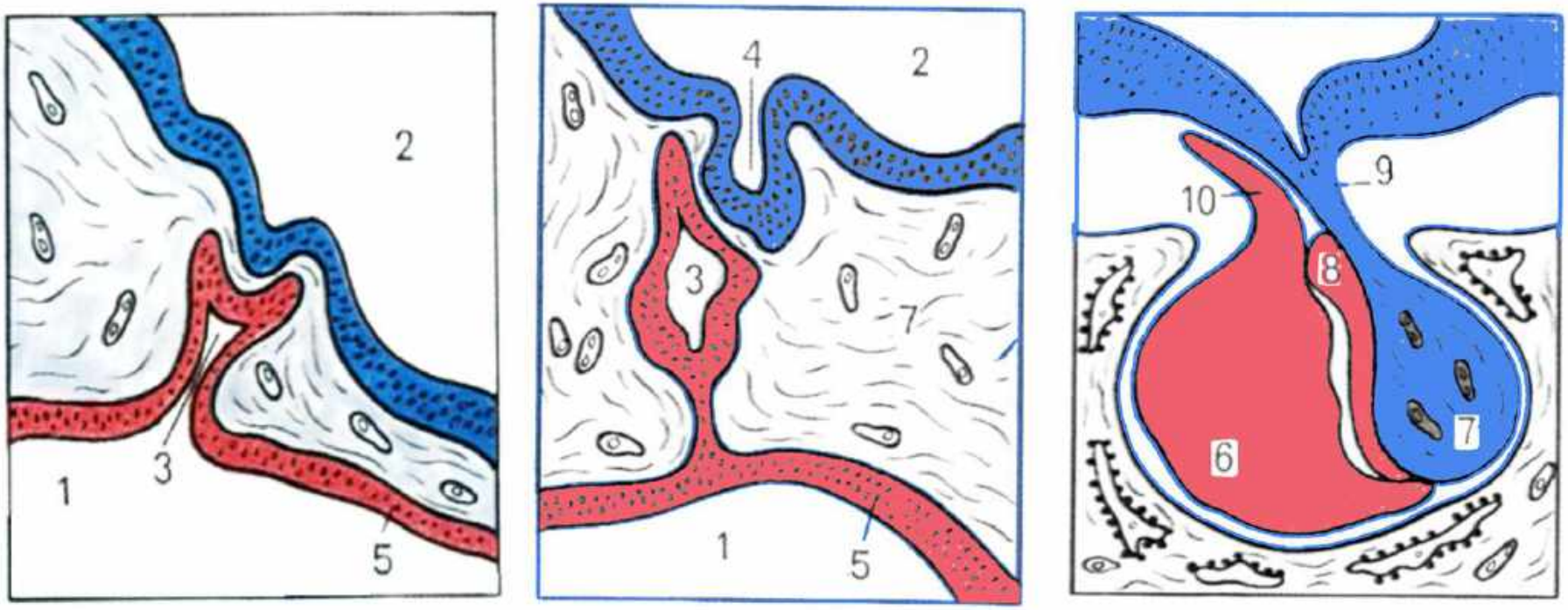
↓

NEUROHYPOPHYSIS →
- **PARS NERVOSA**
- **STALK**
- **INFUNDIBULUM**



1- oral cavity, 2- ventricle of the brain, 3- Rathke's pouch, 4- evagination of the diencephalon, 5- epithelium of the oral pit, 6- pars distalis of the anterior pituitary, 7- posterior pituitary, 8- pars intermedia, 9- hypophyseal stalk, 10- pars tuberalis

PITUITARY GLAND DEVELOPMENT



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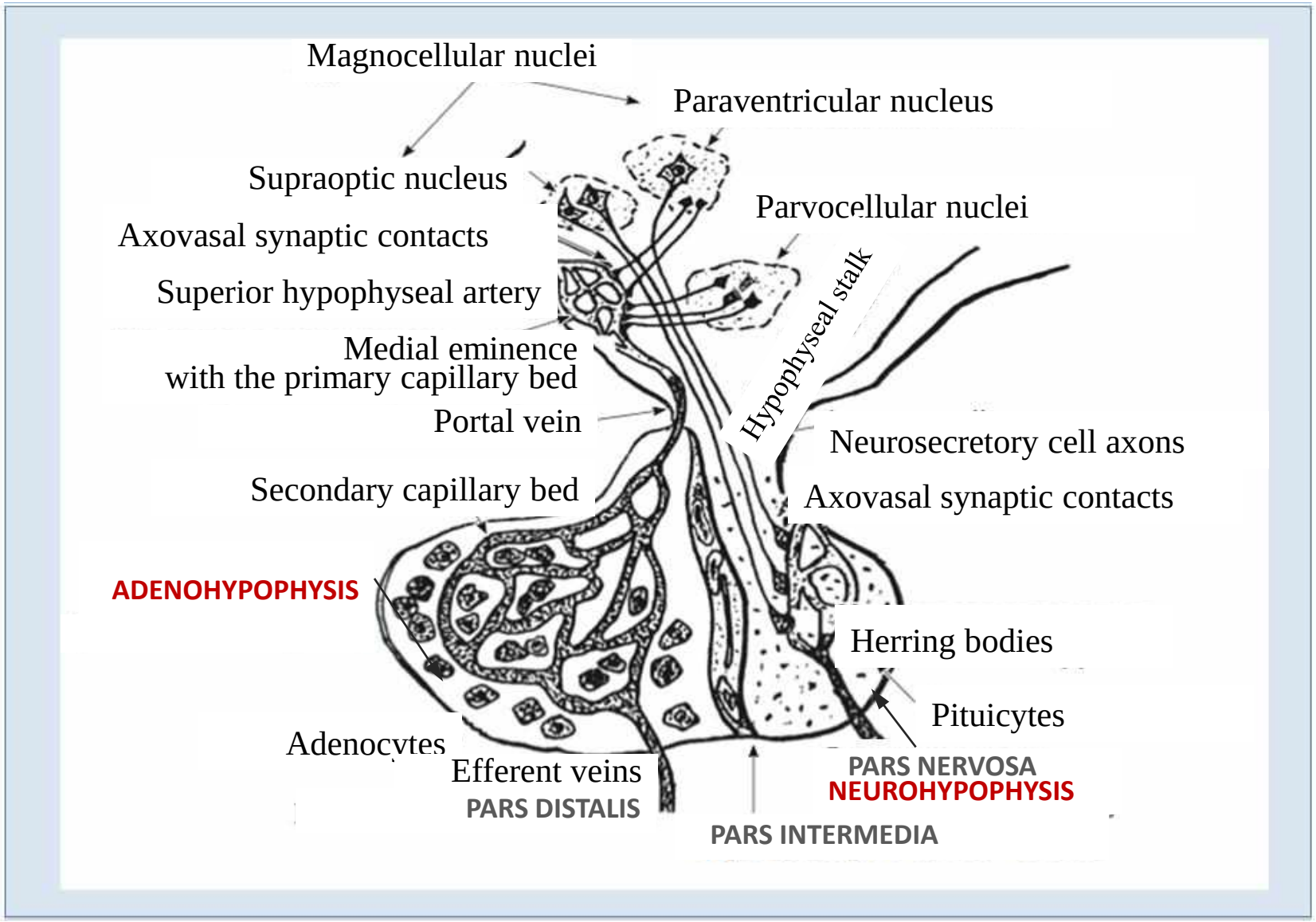
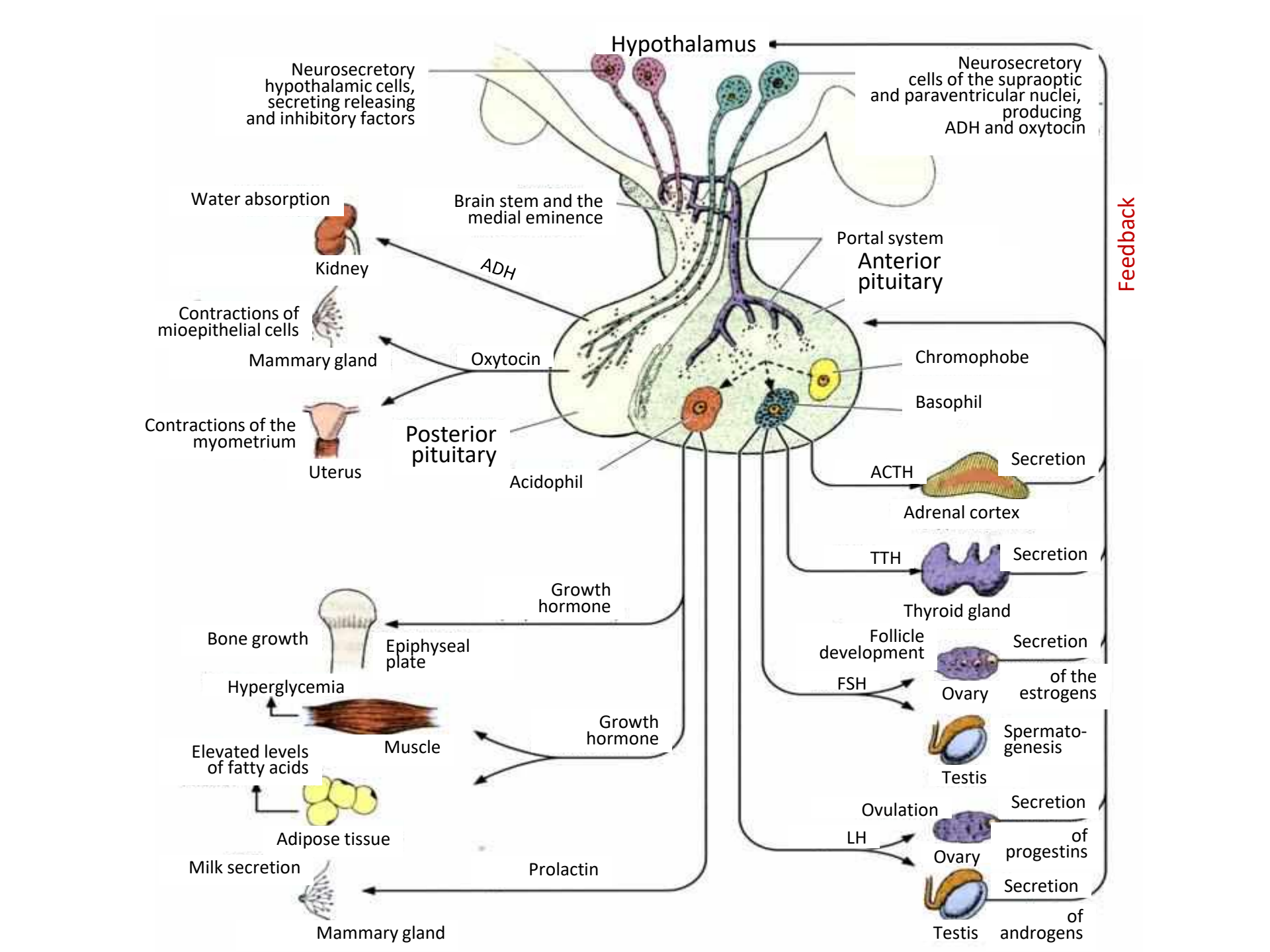
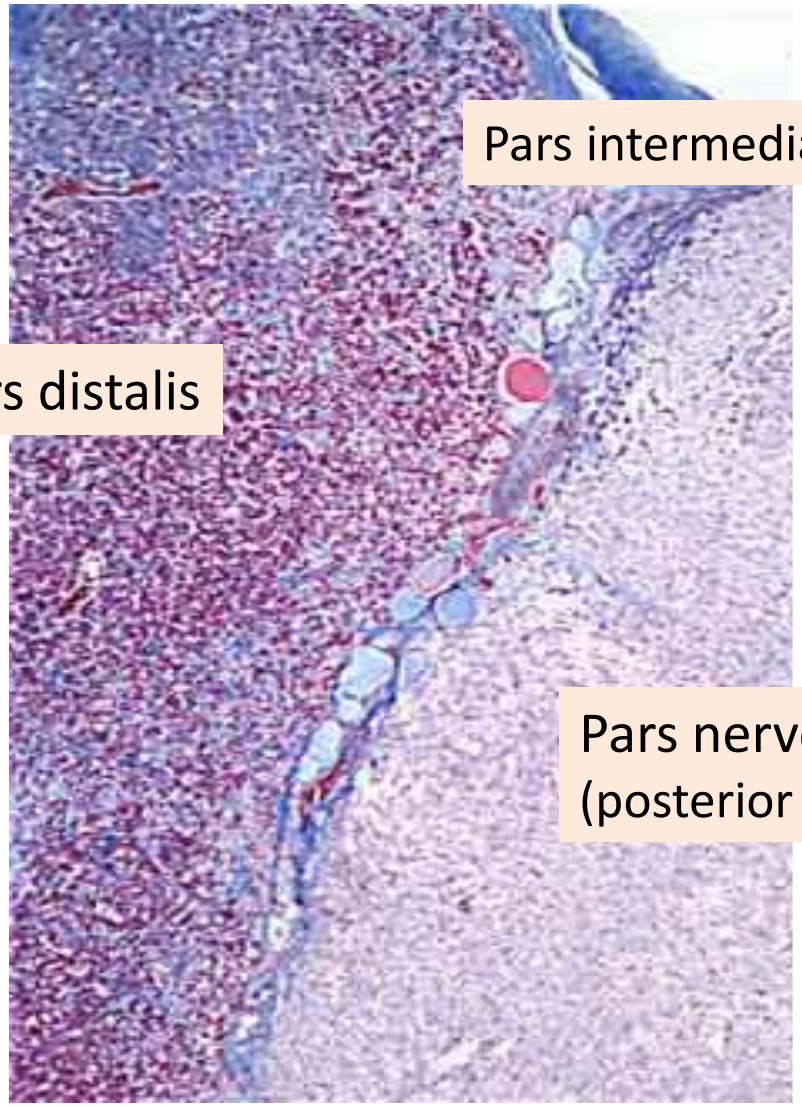
HYPOTHALAMO-HYPOPHYSEAL SYSTEM

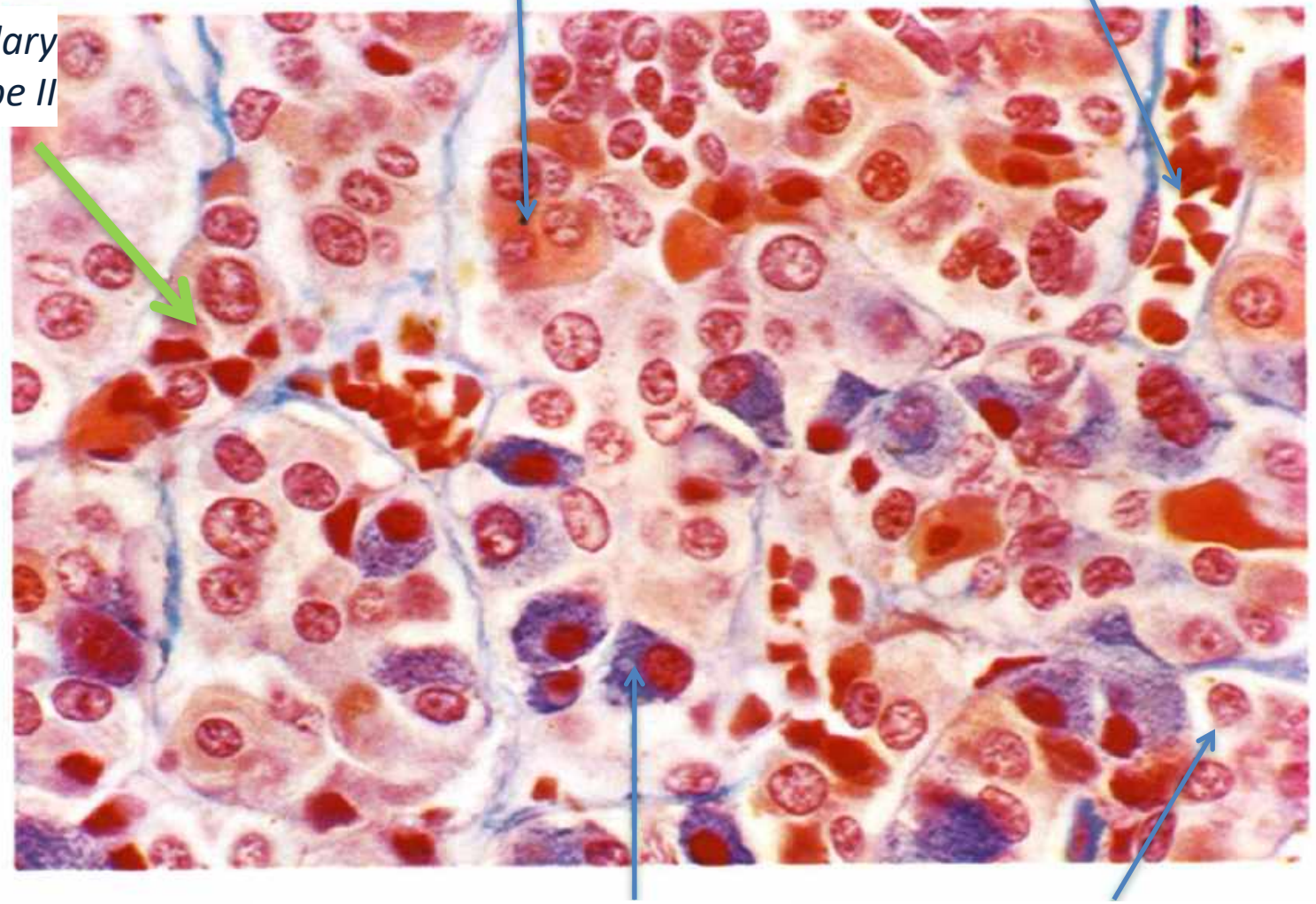



Hypothalamus
Neurosecretory hypothalamic cells, secreting releasing and inhibitory factors
Neurosecretory cells of the supraoptic and paraventricular nuclei, producing ADH and oxytocin
Feedback
Water absorption
Kidney
ADH
Brain stem and the medial eminence
Portal system
Anterior pituitary
Contractions of mioepithelial cells
Mammary gland
Oxytocin
Chromophobe
Basophil
Contractions of the myometrium
Uterus
Posterior pituitary
Acidophil
ACTH
Secretion
Adrenal cortex
TTH
Secretion
Thyroid gland
Growth hormone
Bone growth
Epiphyseal plate
Follicle development
Secretion
FSH
Ovary
of the estrogens
Hyperglycemia
Muscle
Growth hormone
Spermato-genesis
Testis
Elevated levels of fatty acids
Adipose tissue
Ovulation
Secretion
LH
Ovary
of progestins
Milk secretion
Prolactin
Secretion
Mammary gland
Testis
of androgens

PITUITARY GLAND



Pars distalis (anterior lobe) of the ADENOHYPOPHYSIS



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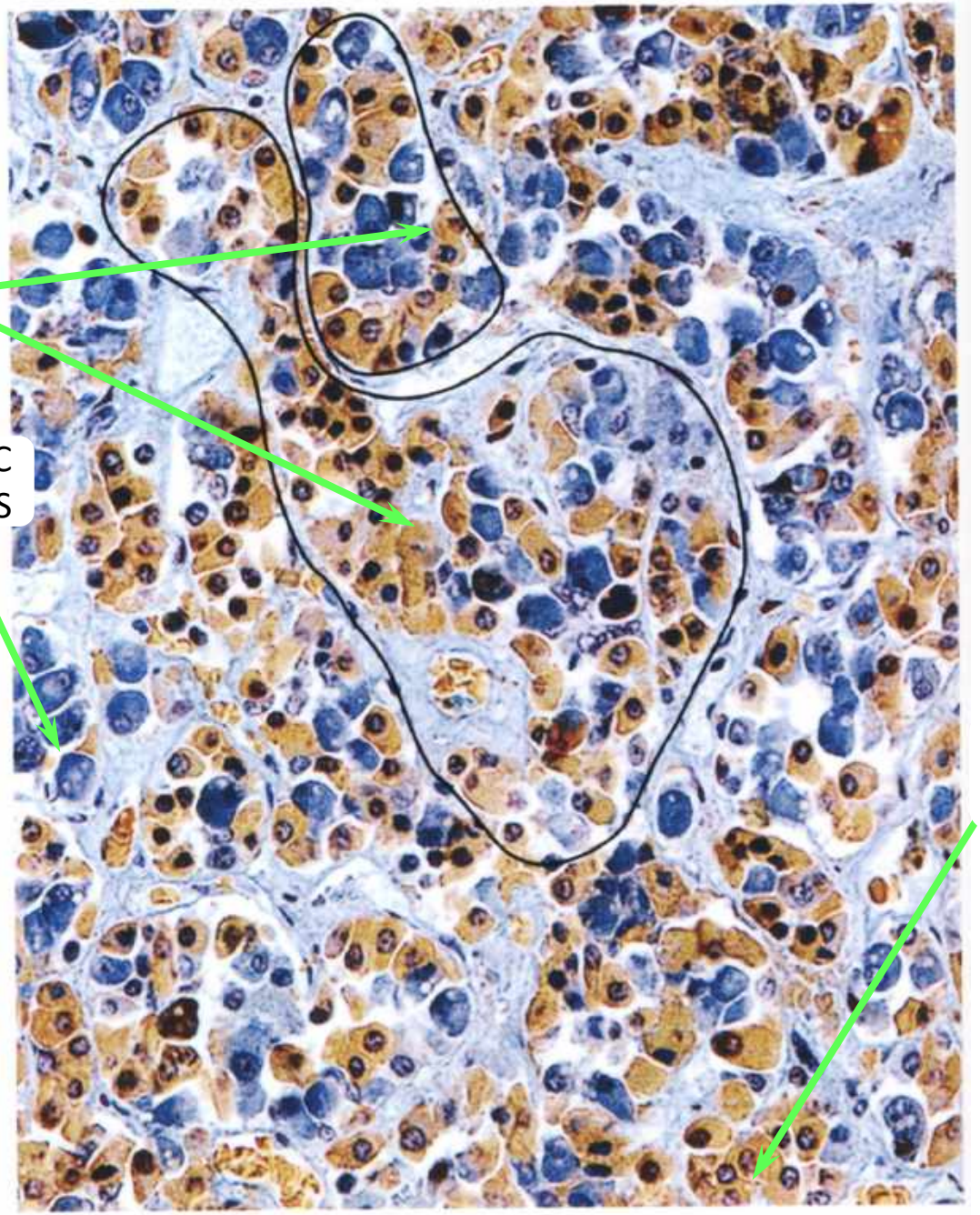
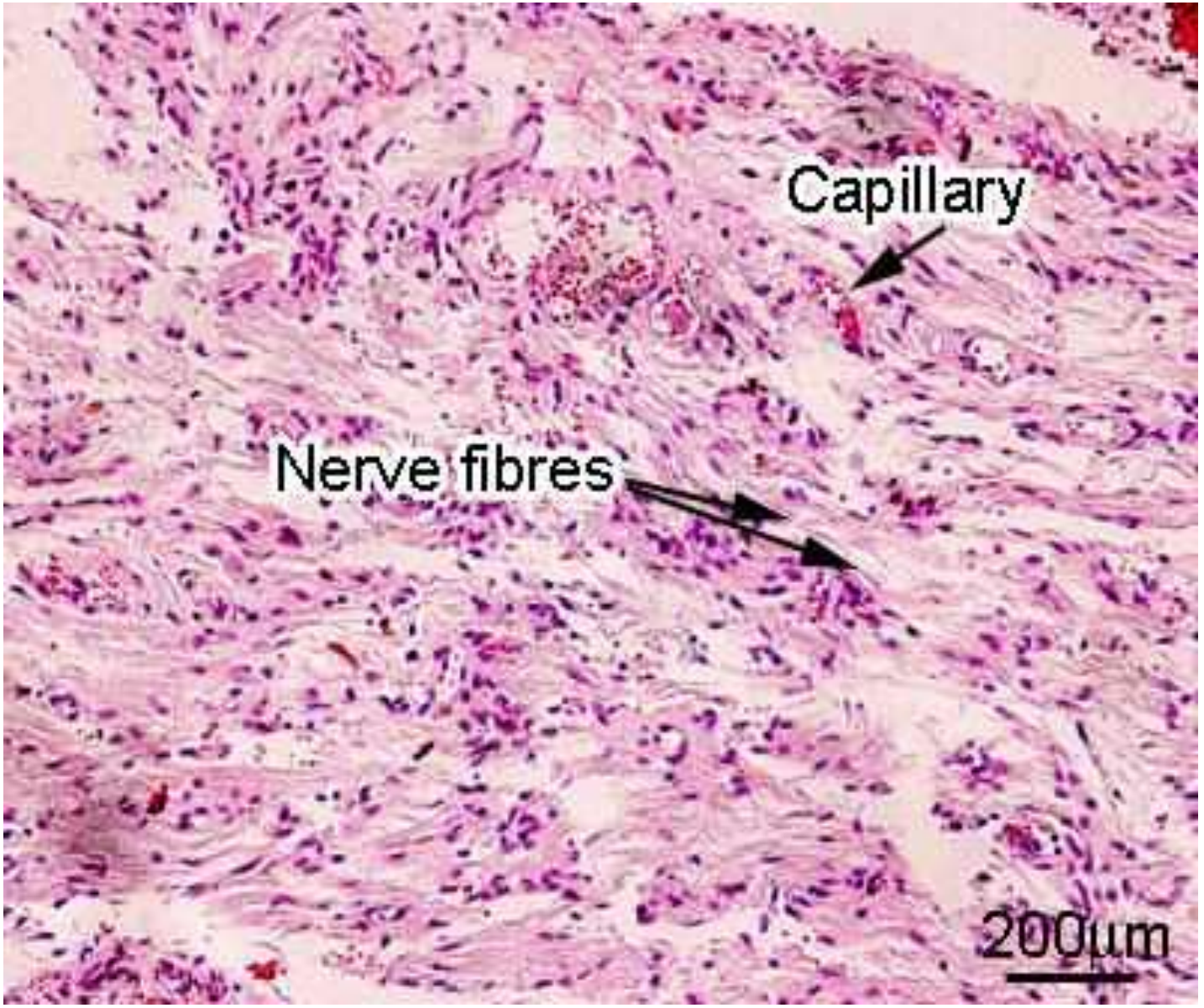
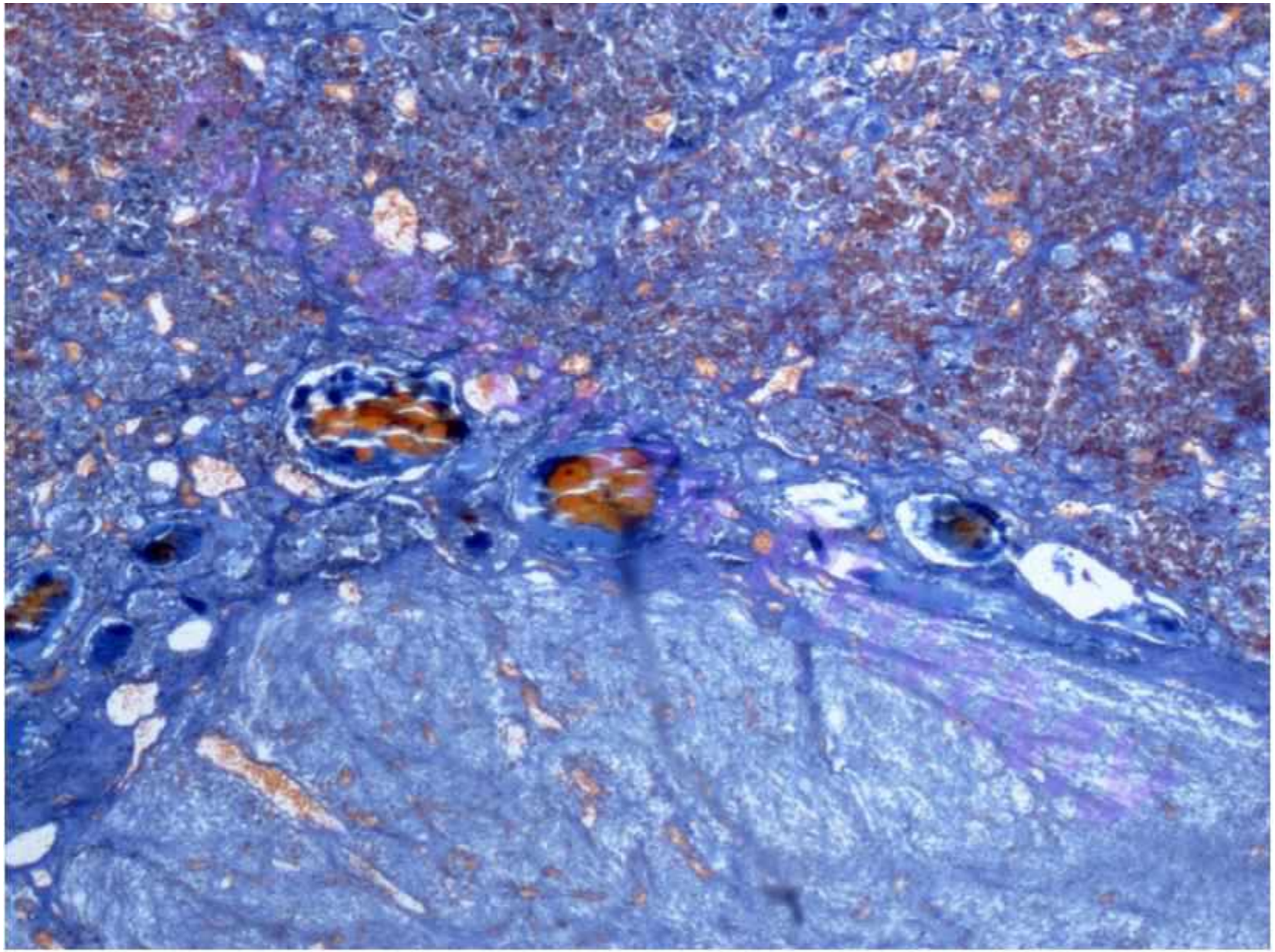


NEUROHYPOPHYSIS (pars nervosa, posterior pituitary)



*Slide №109 "*Pituitary gland (hypophysis), human"
Stained with Mallory's trichrome



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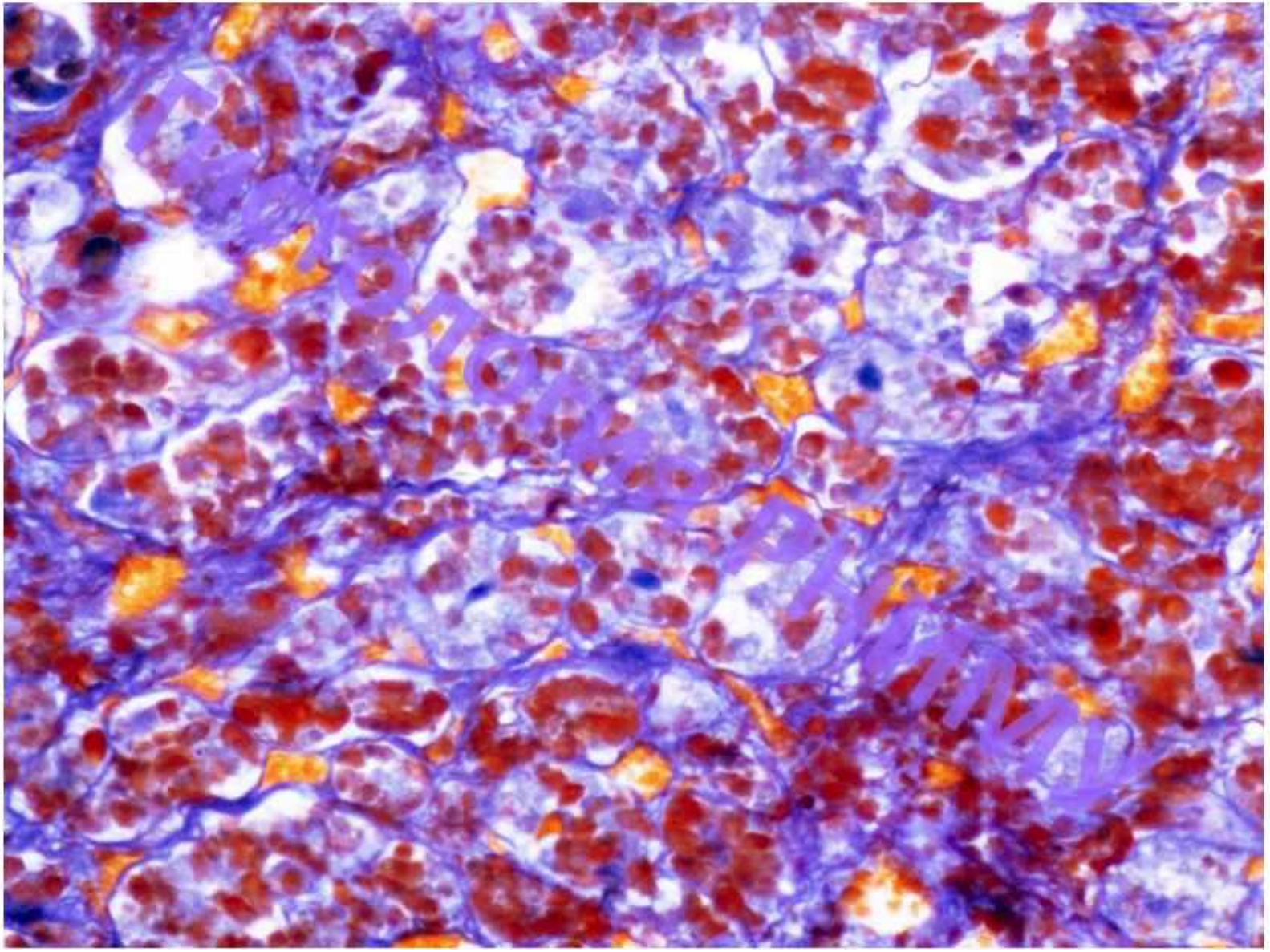

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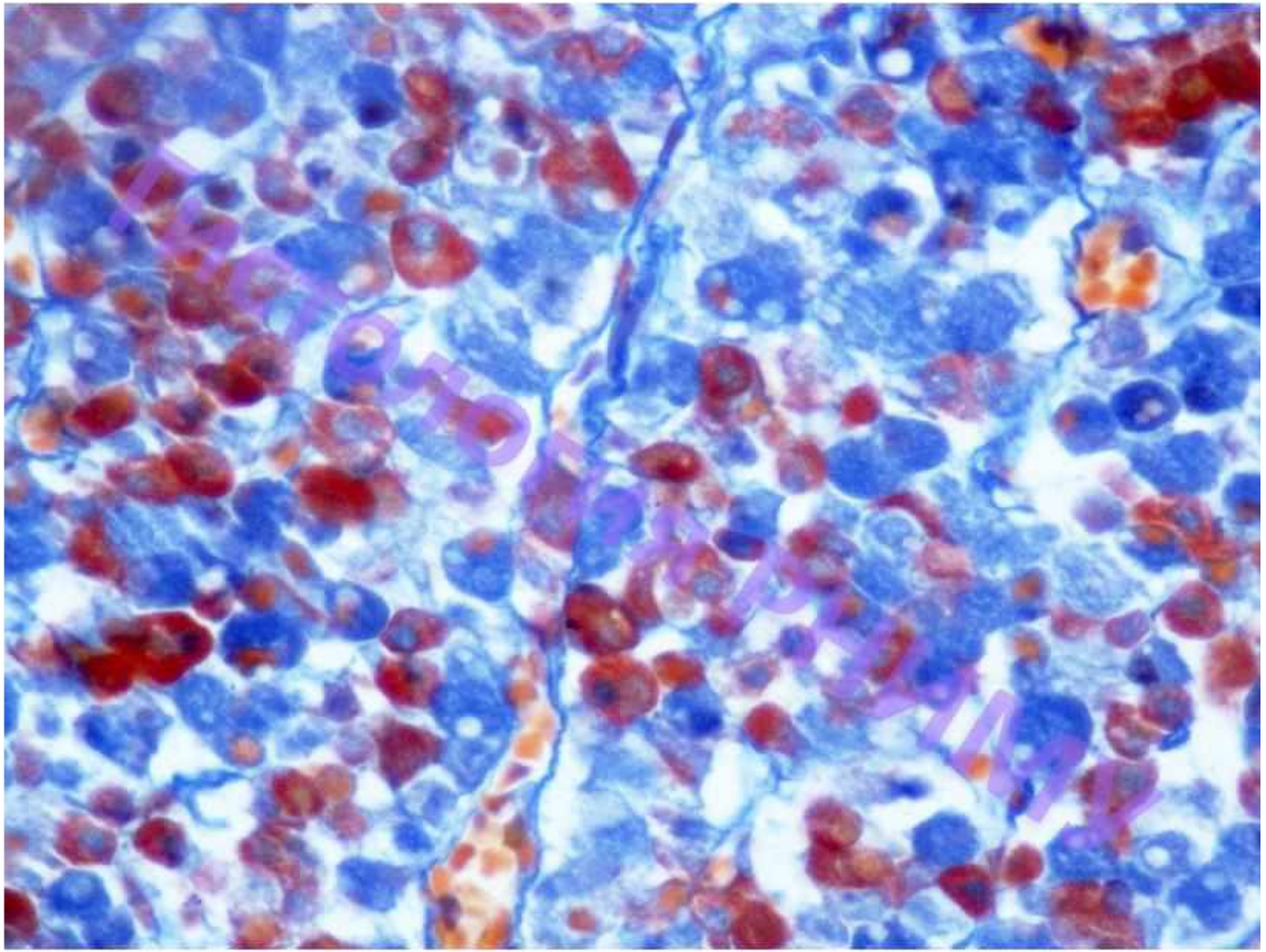

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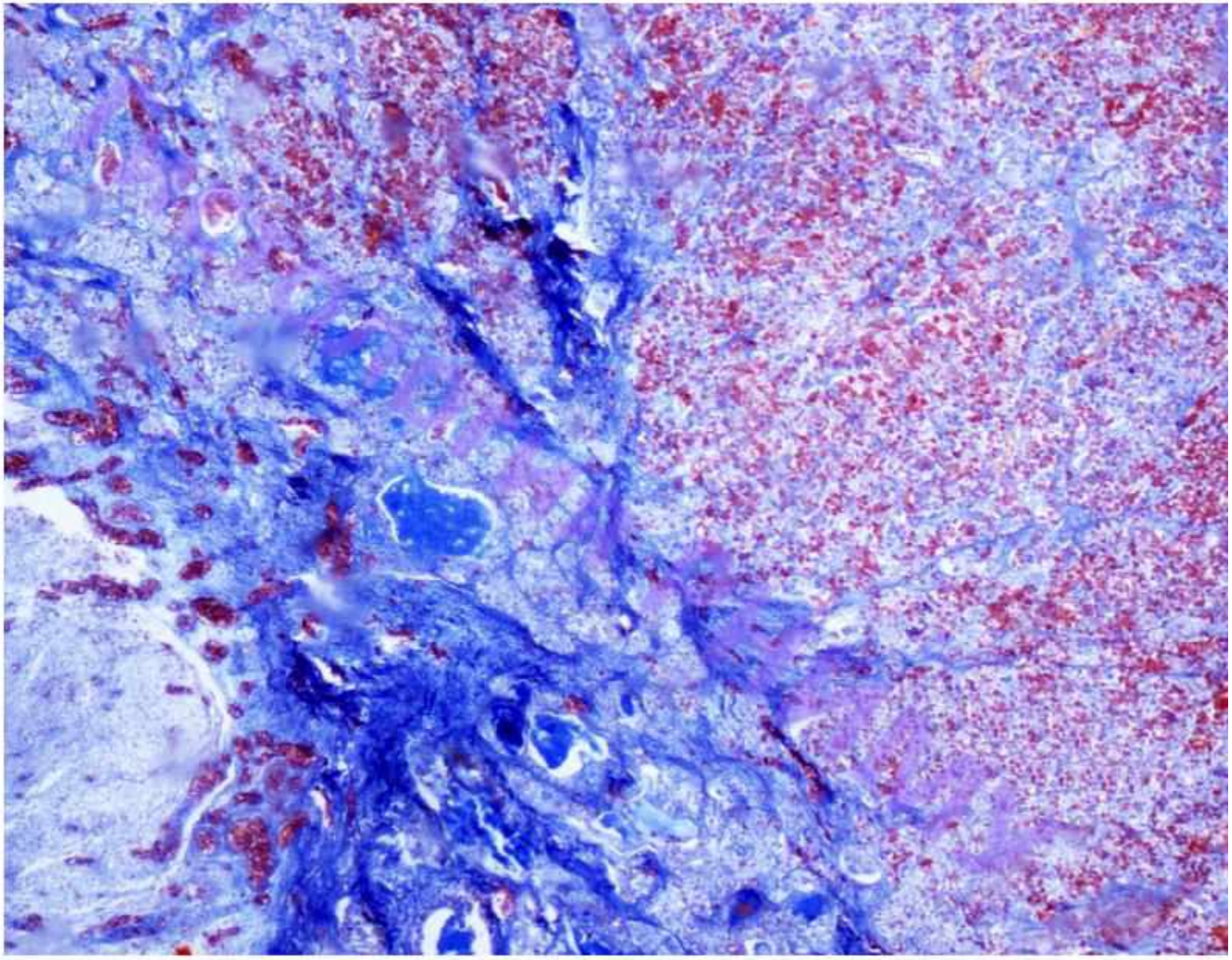

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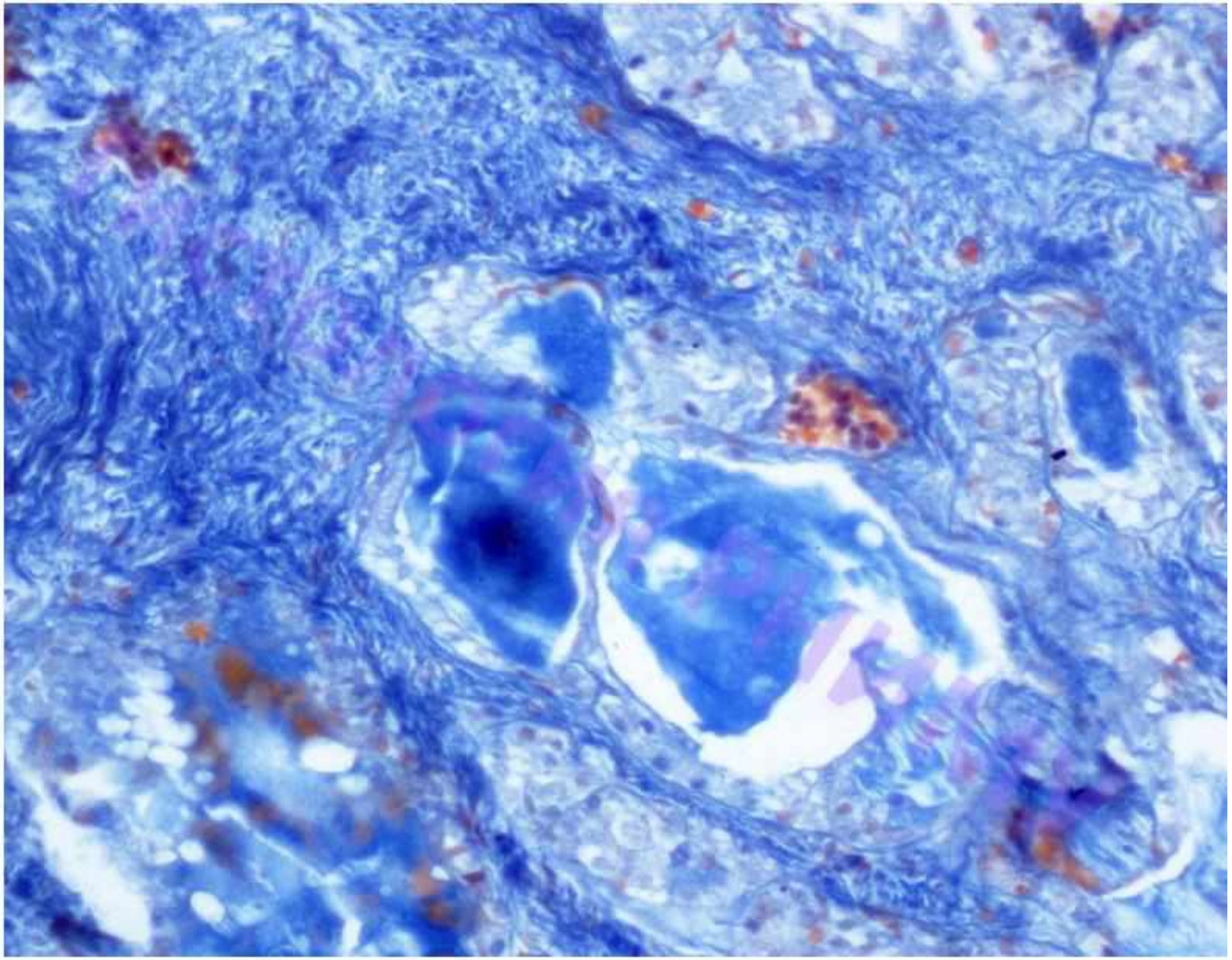

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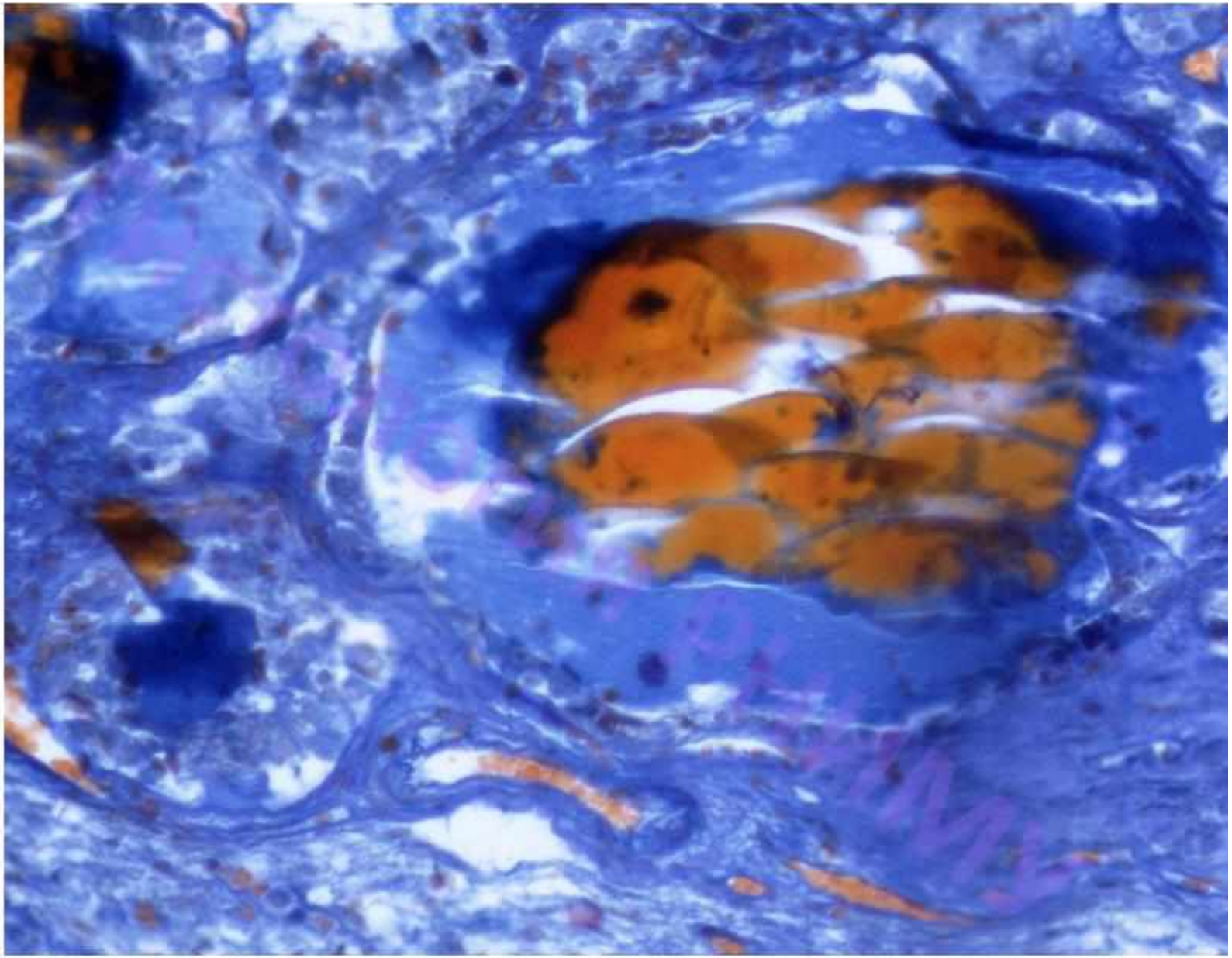

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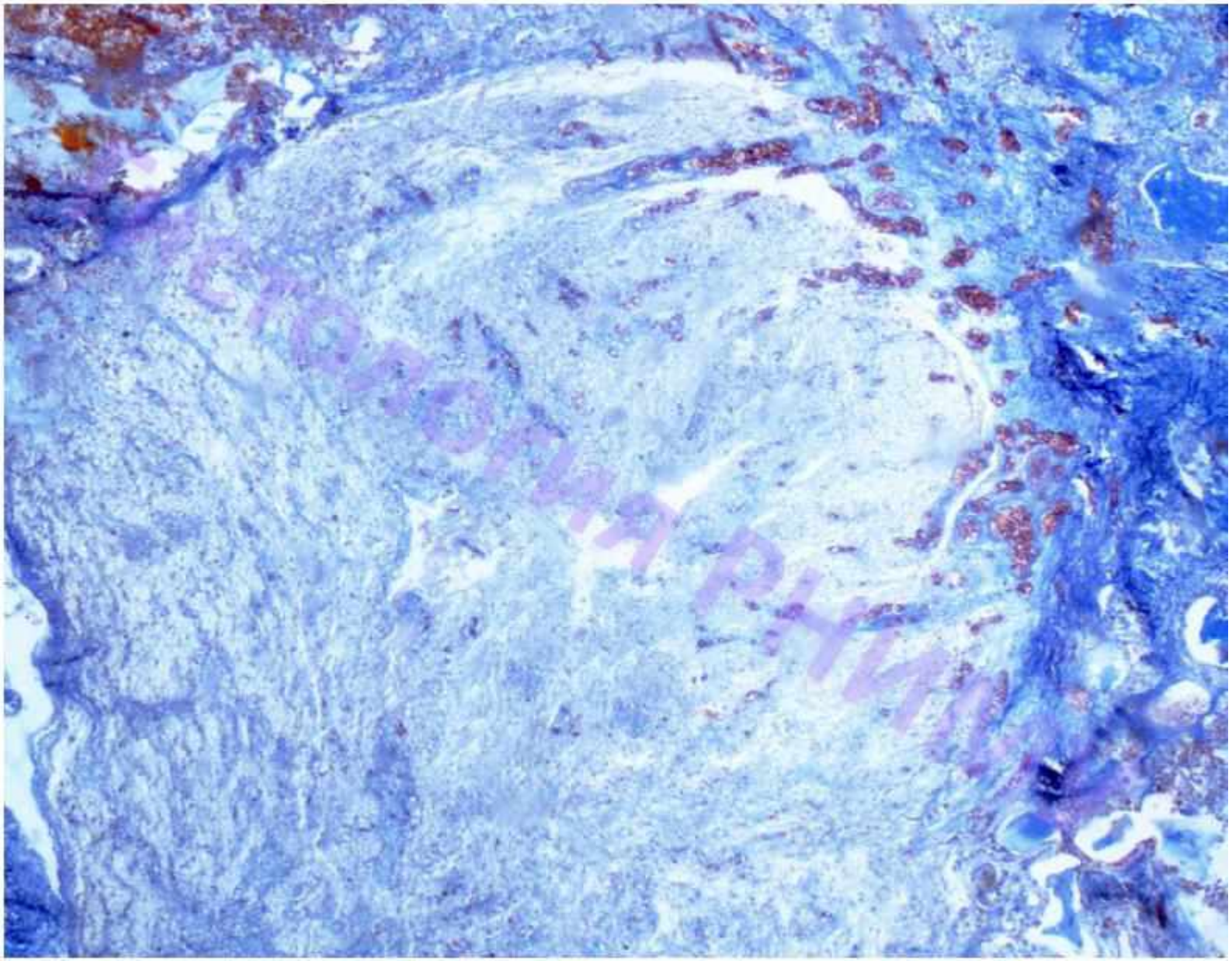

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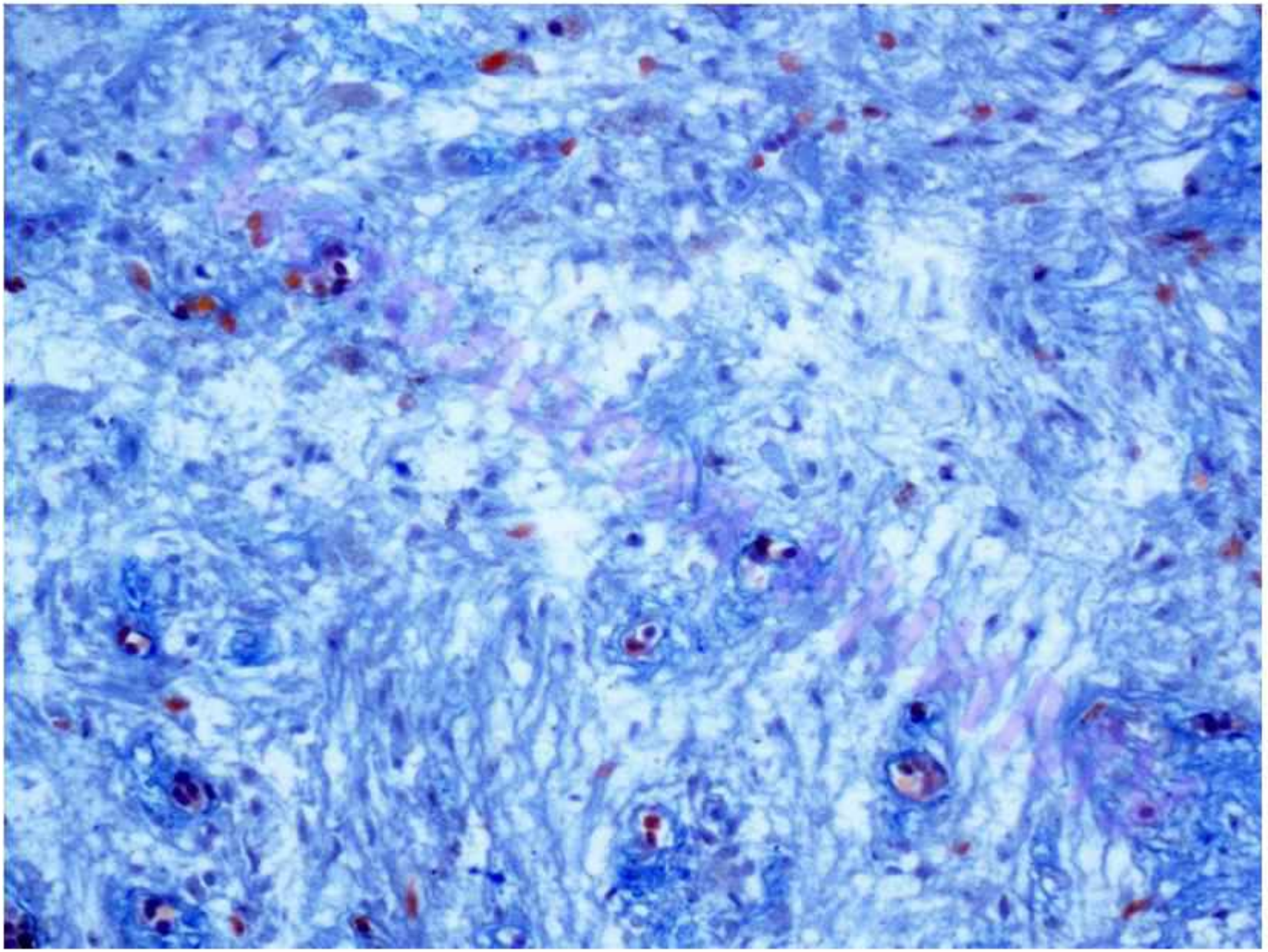

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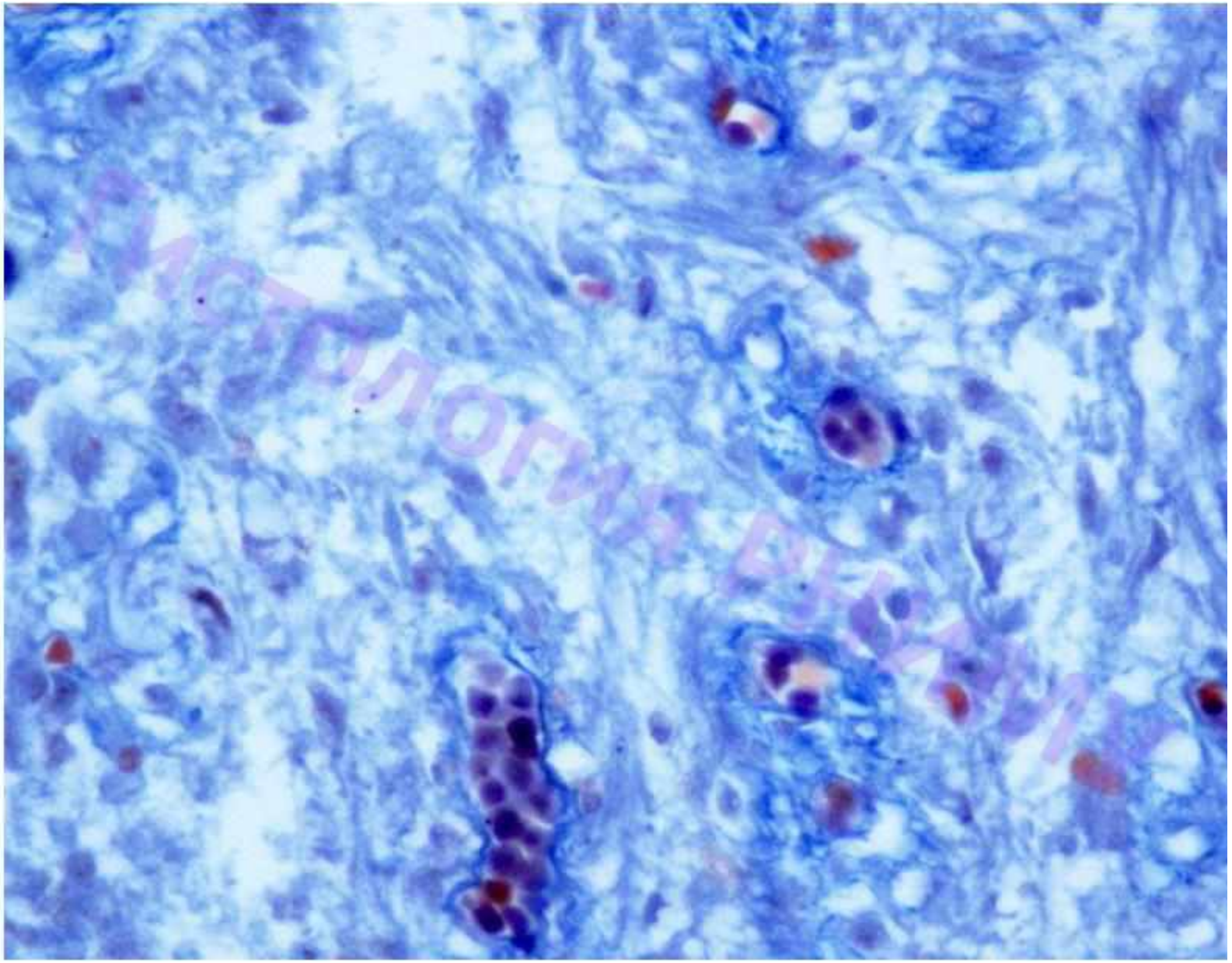
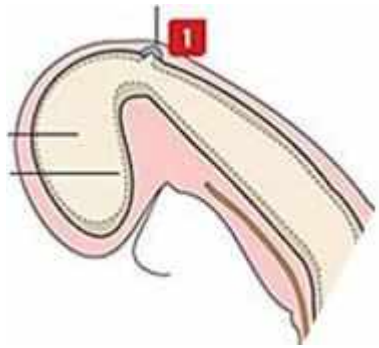
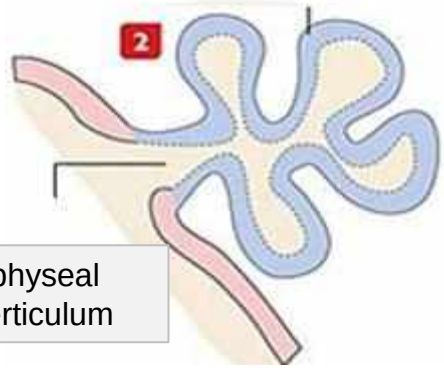
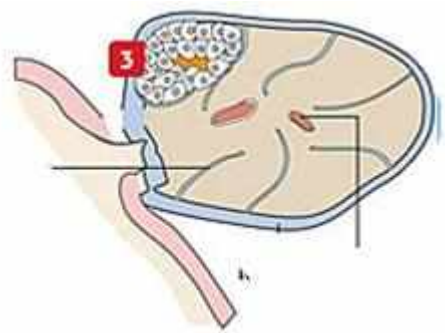


EPIPHYSIS *(pineal gland) DEVELOPMENT*





Epiphyseal diverticulum

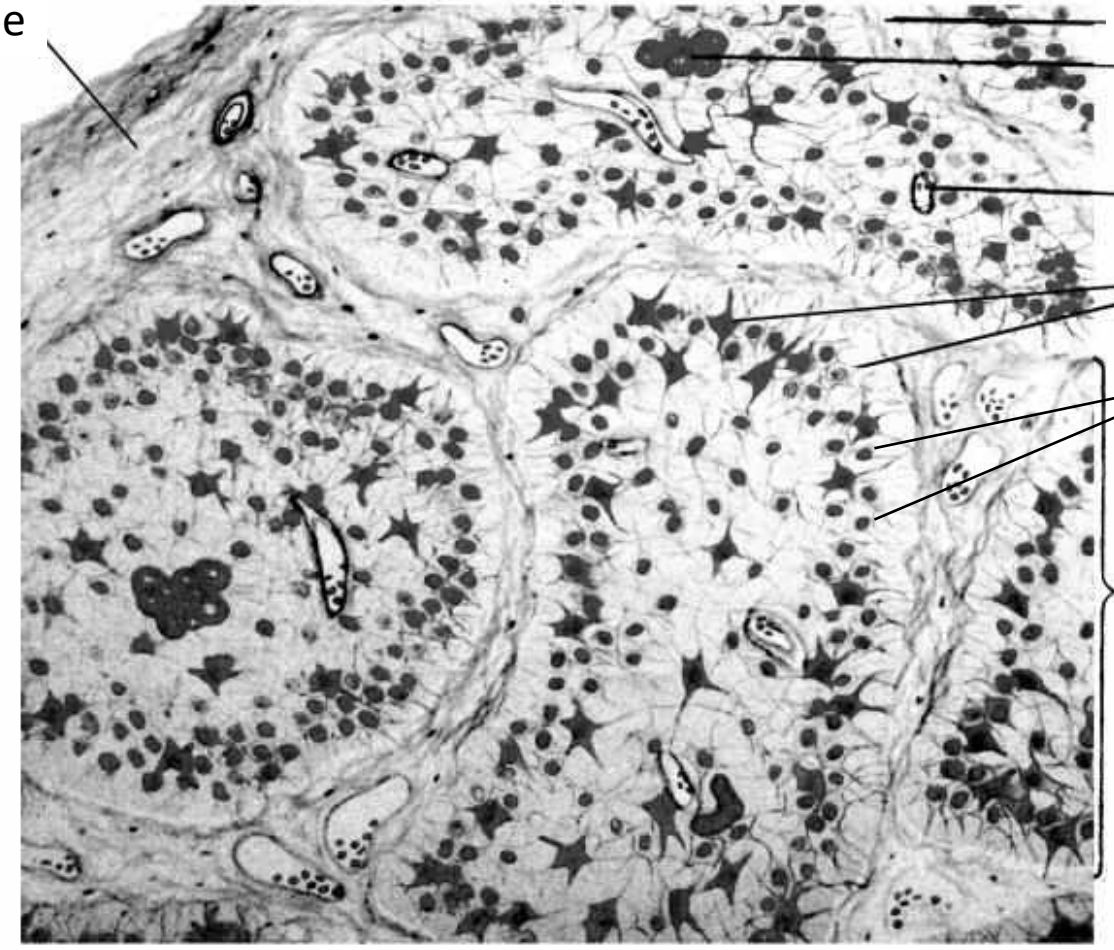


1 – Evagination in the roof of the 3rd brain ventricle

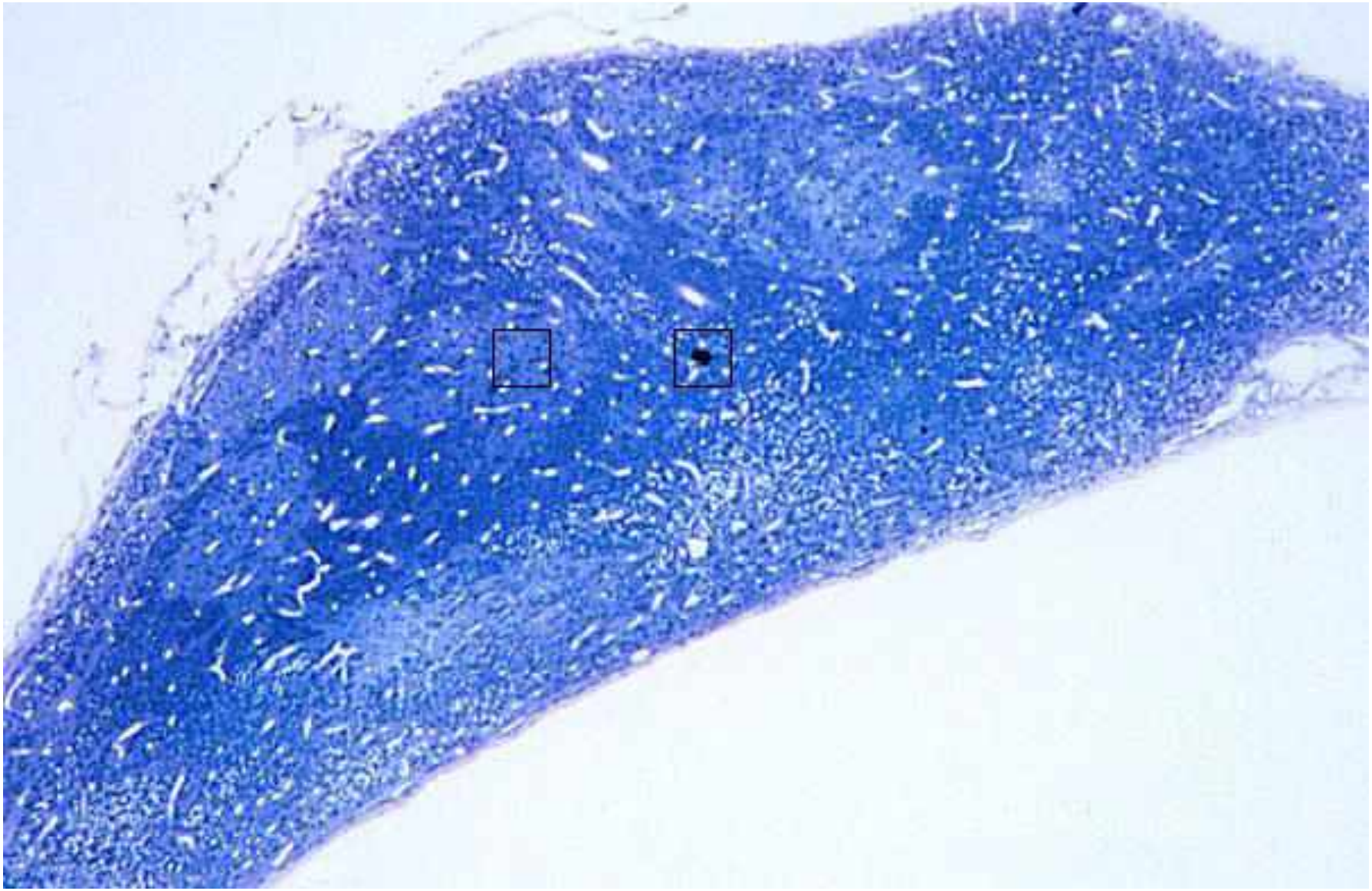
2 – Formation of the dorsal diverticulum

3 – Growth and thickening of the wall of the diverticulum, accompanied by ingrowth of connective tissue septa and blood vessels

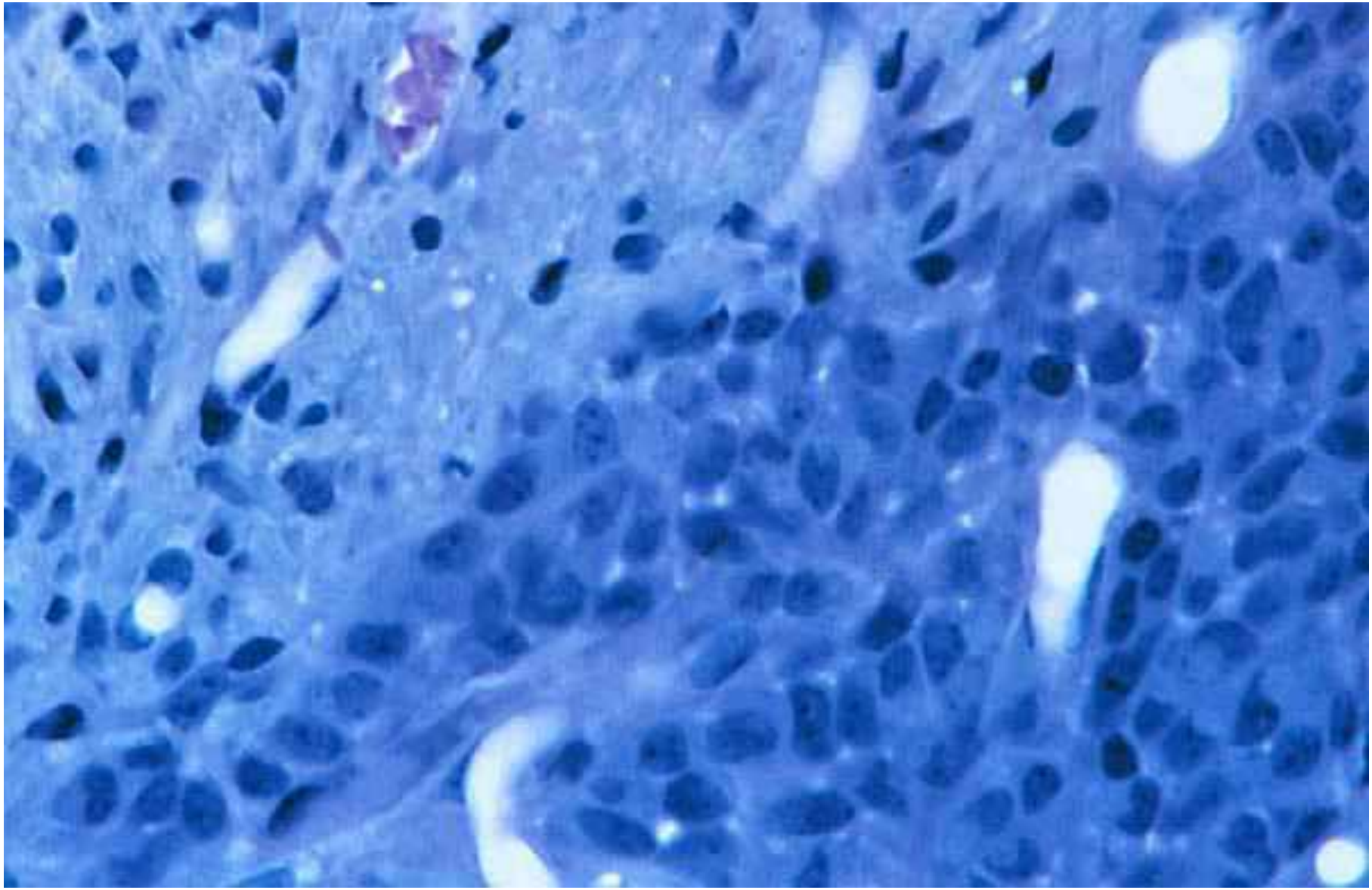
EPIPHYSIS (pineal gland)



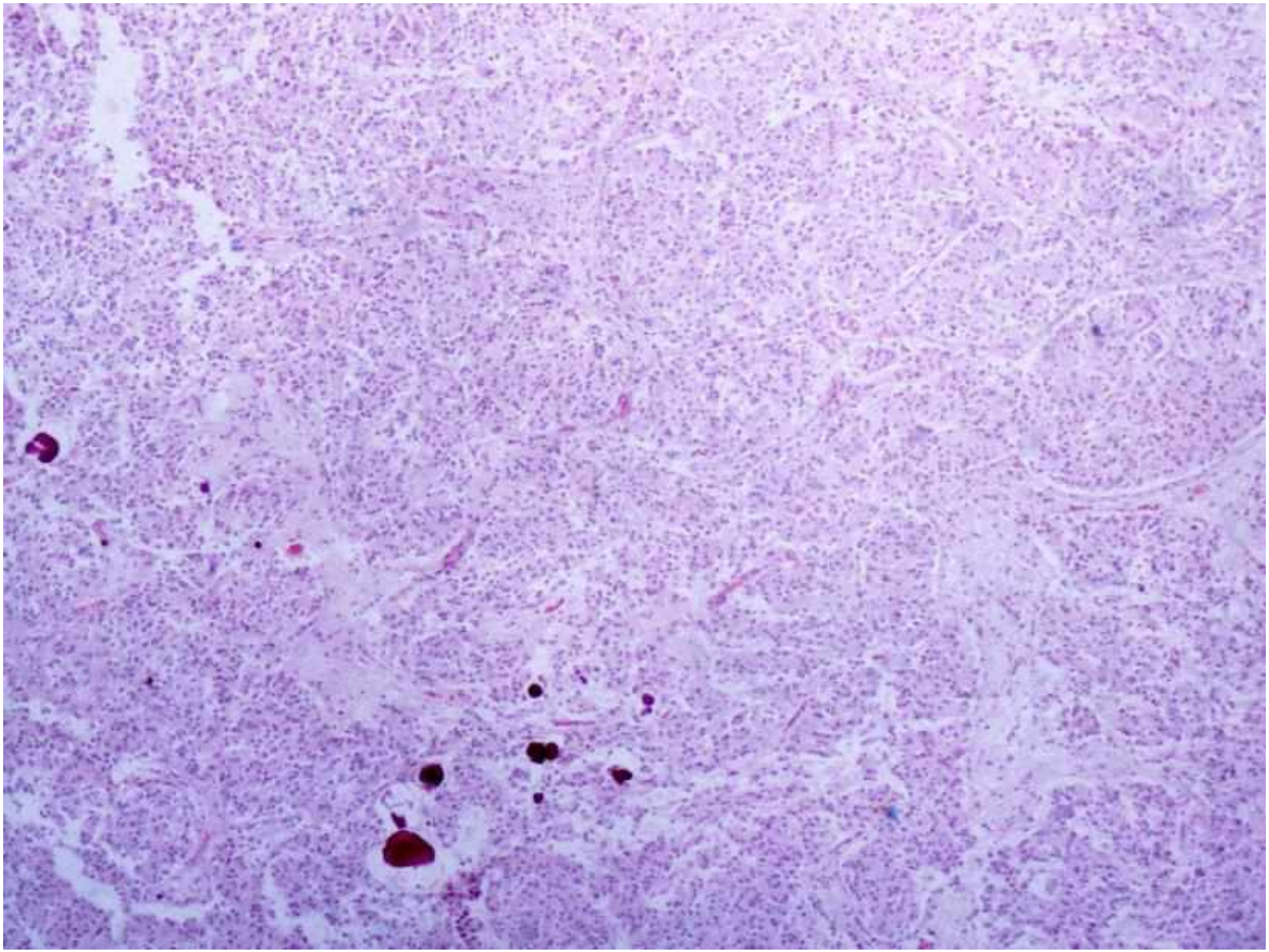
EPIPHYSIS



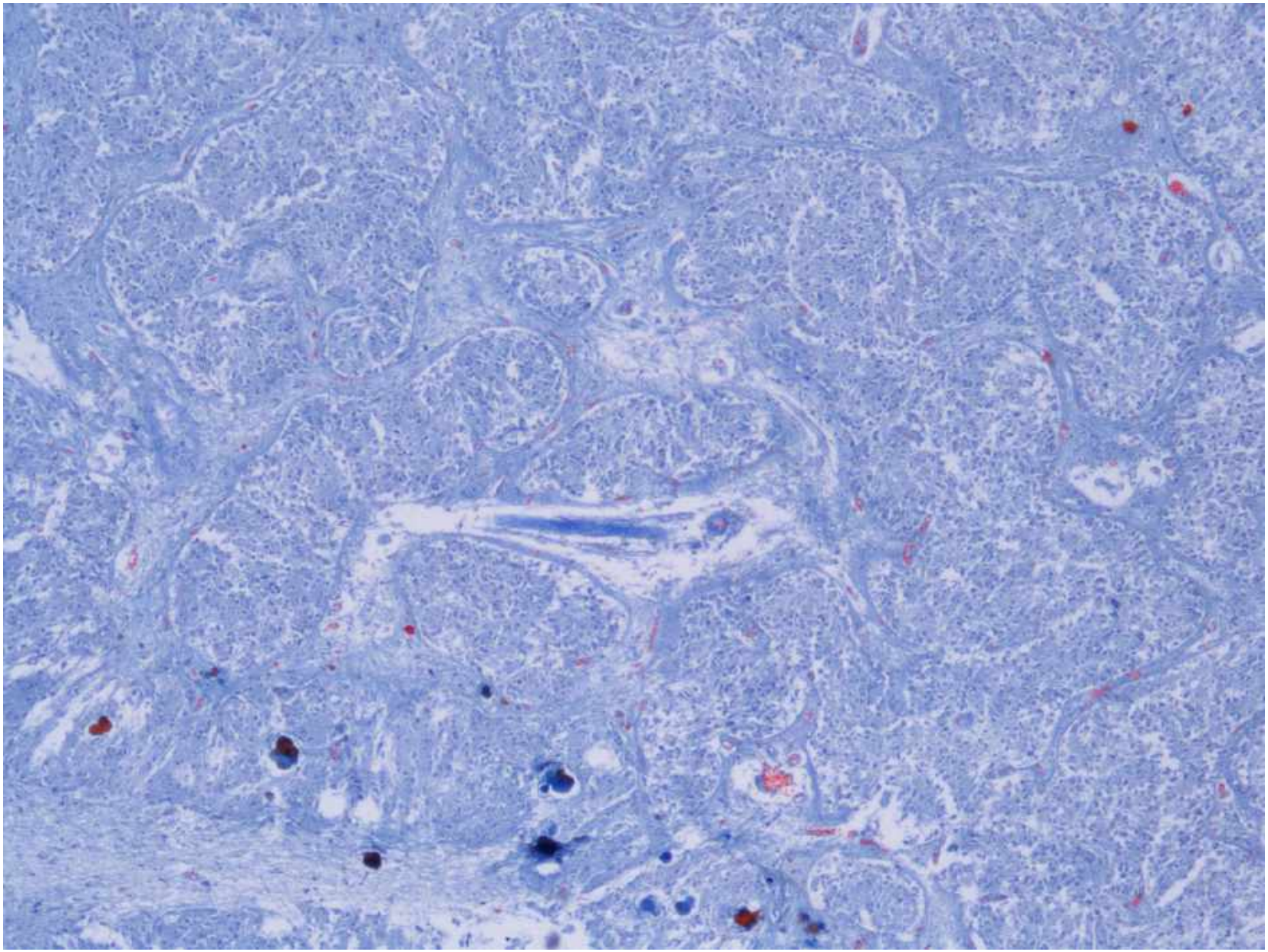
EPIPHYSIS



*Slide №113 "*Pineal gland (epiphysis), human, H&E"



Slide №113 "Pineal gland (epiphysis), human"



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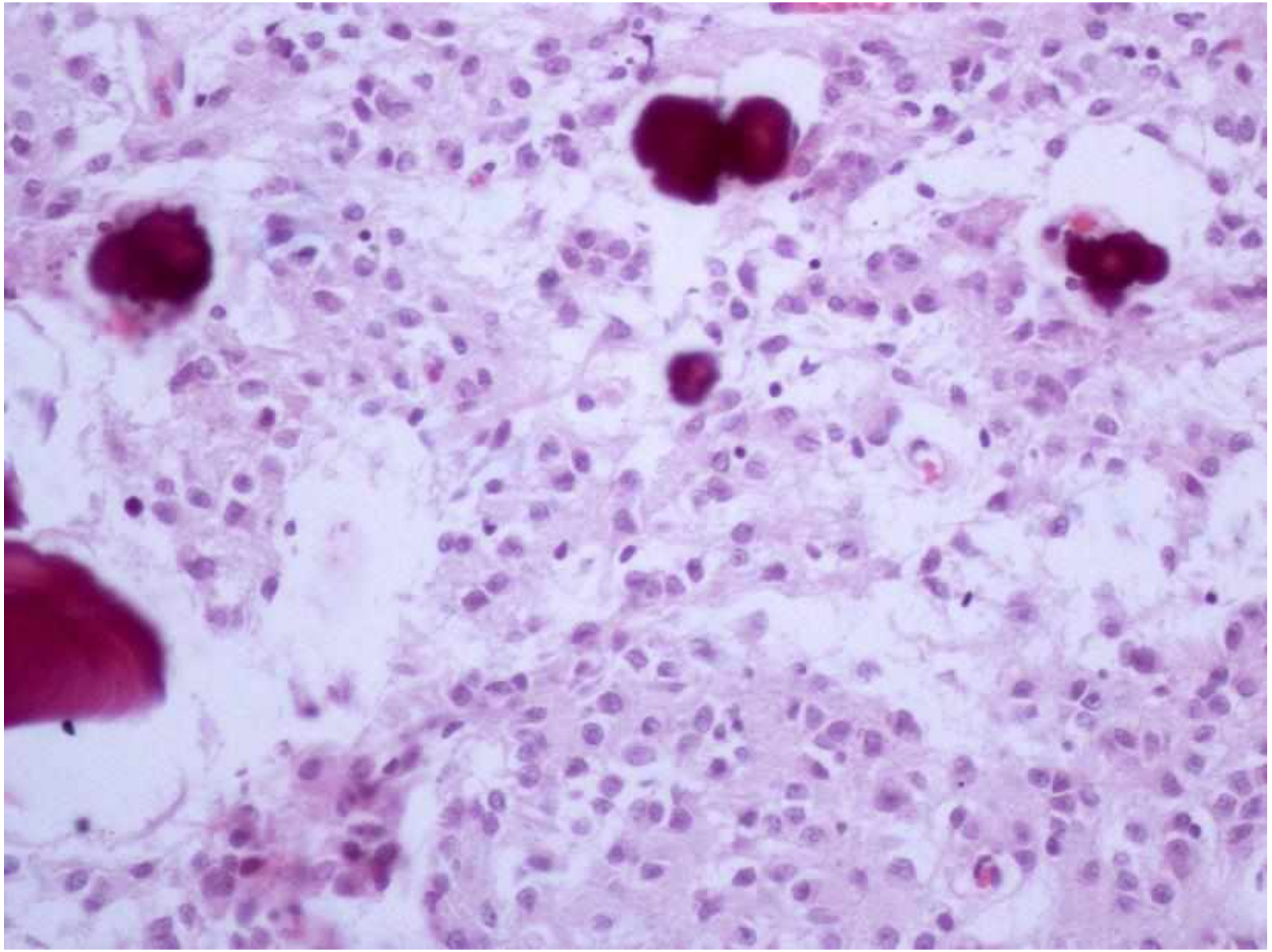

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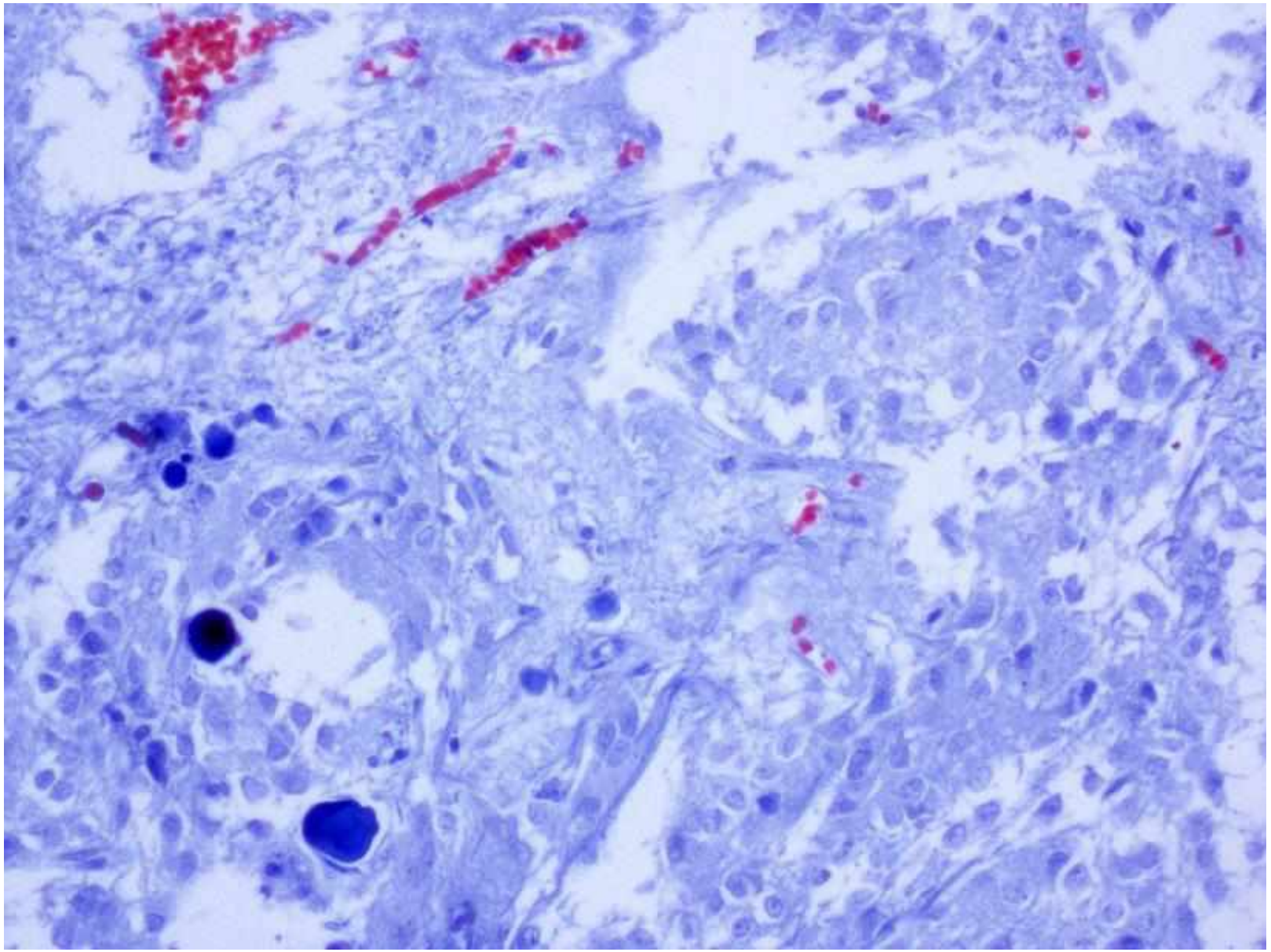

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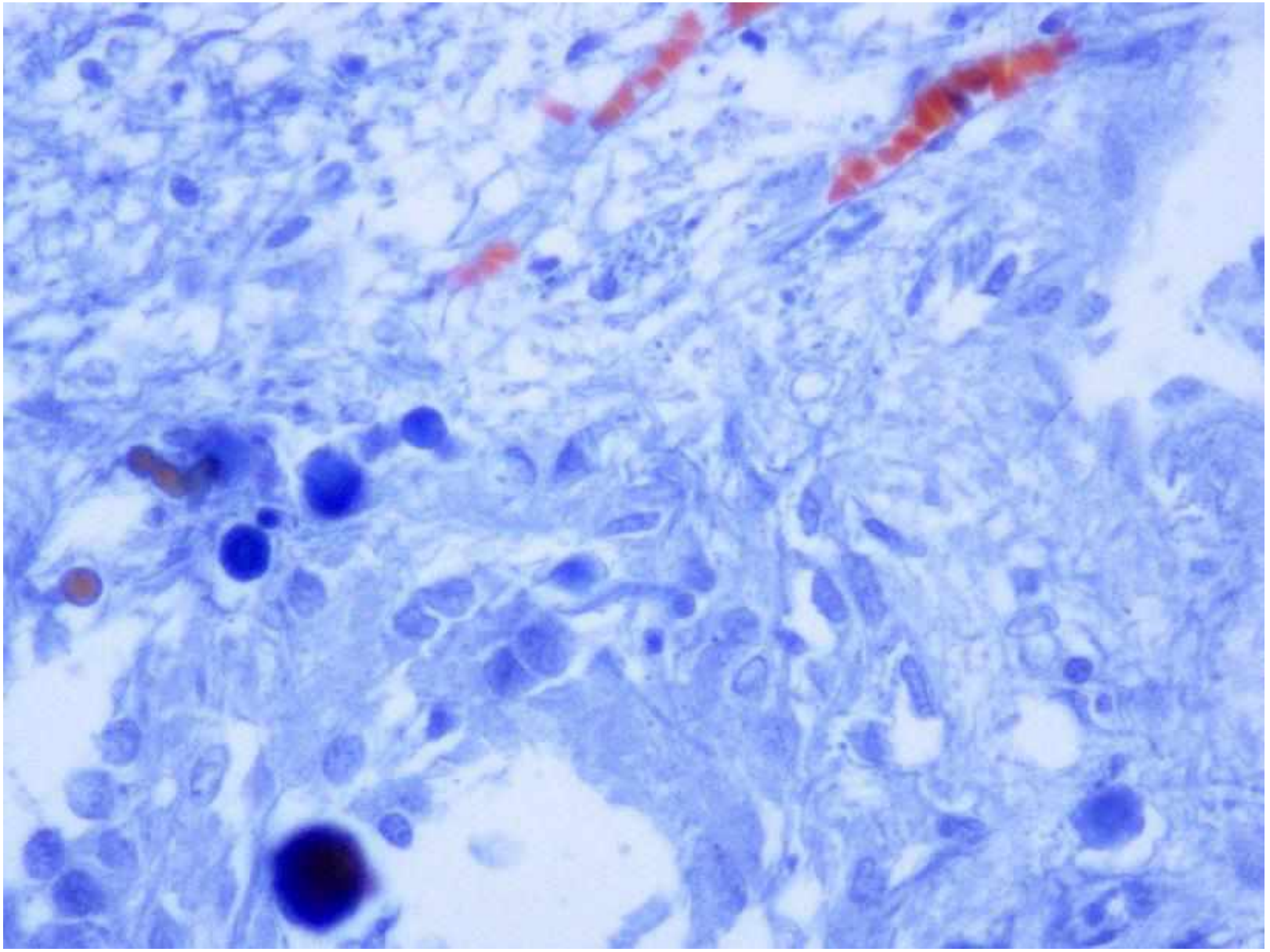

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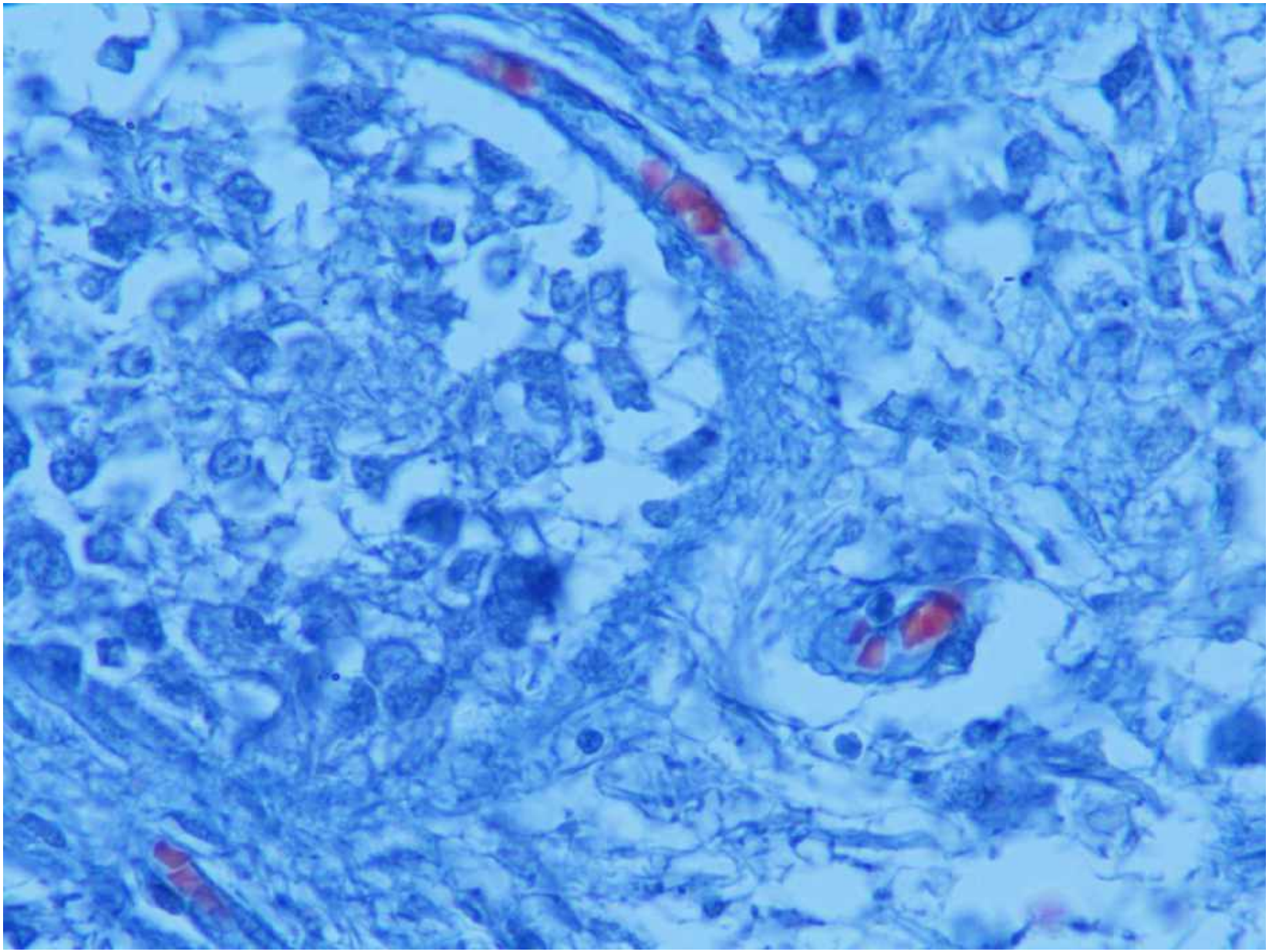

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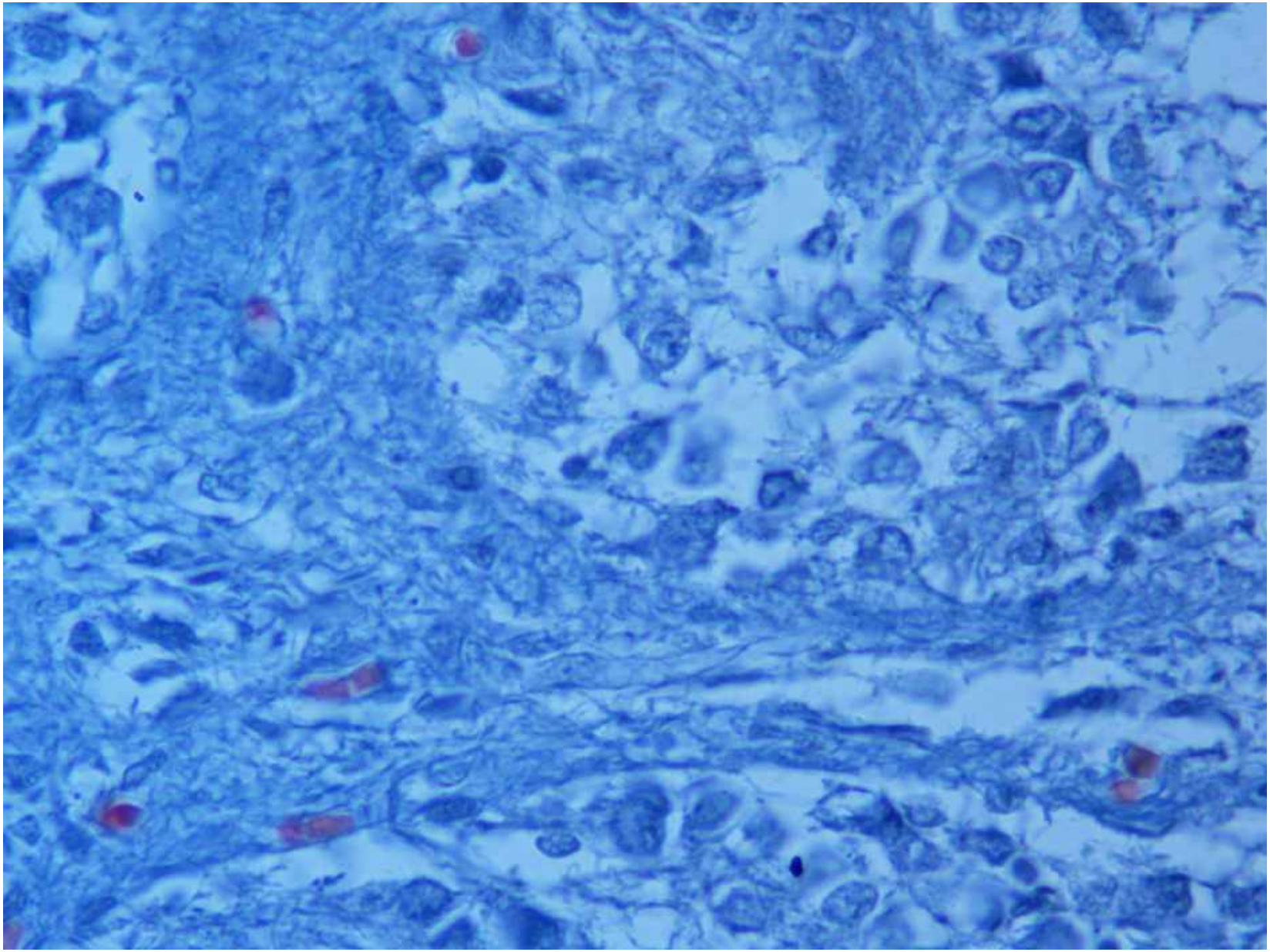

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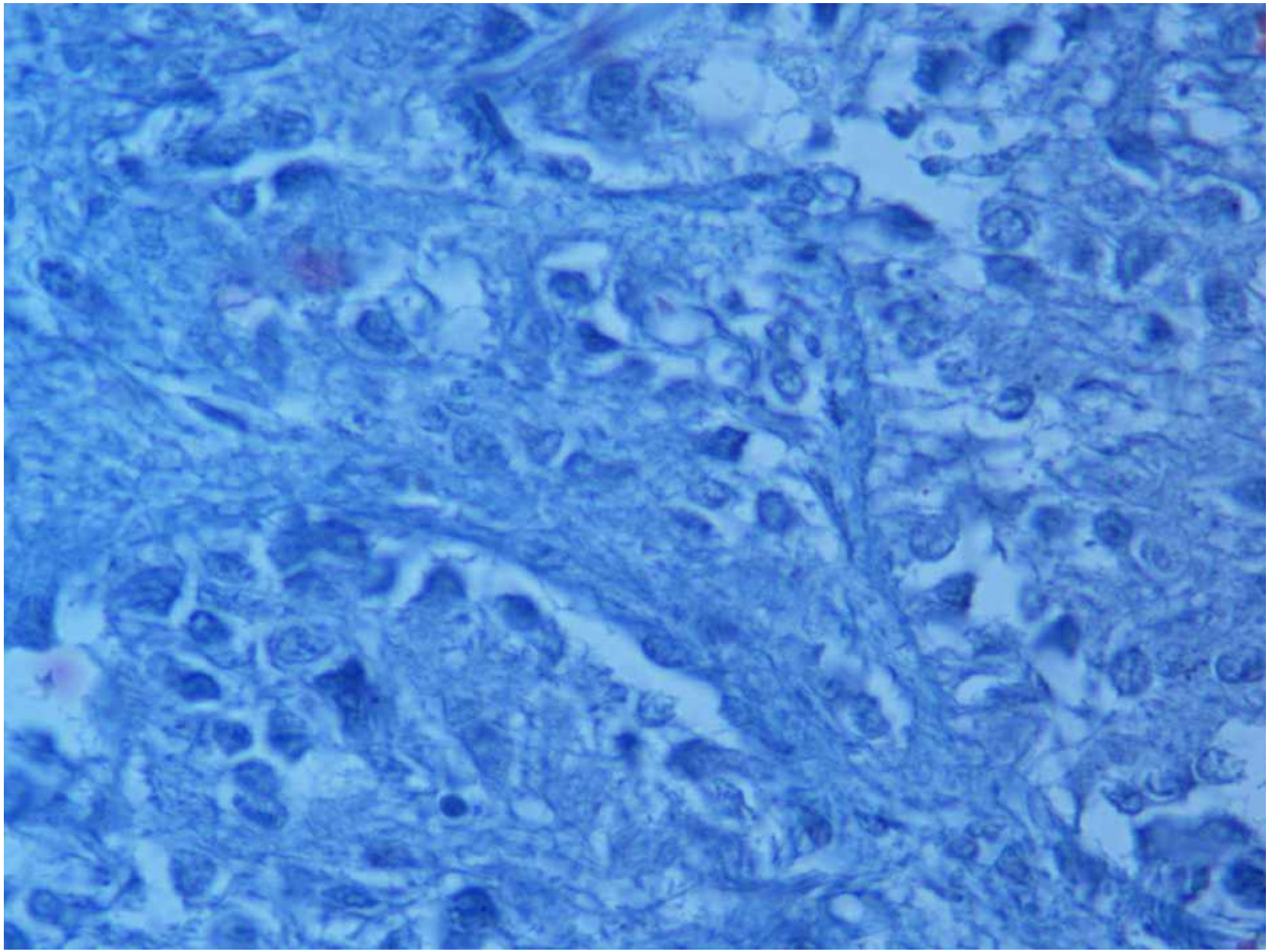
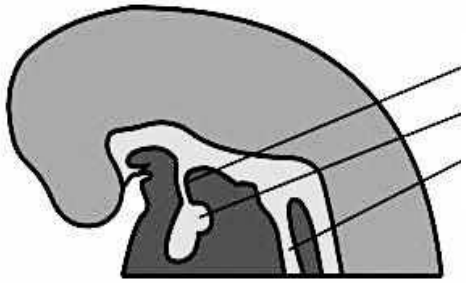
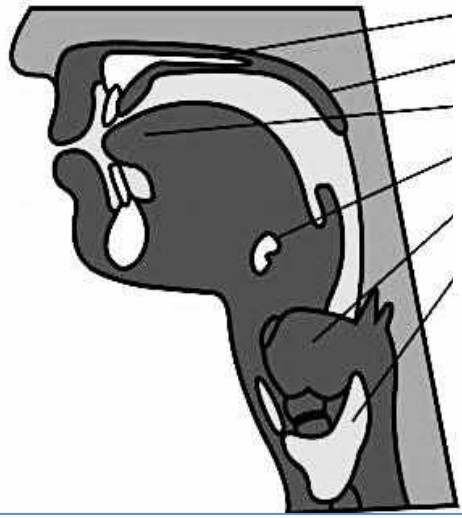


THYROID GLAND *DEVELOPMENT*





3rd to 4th week

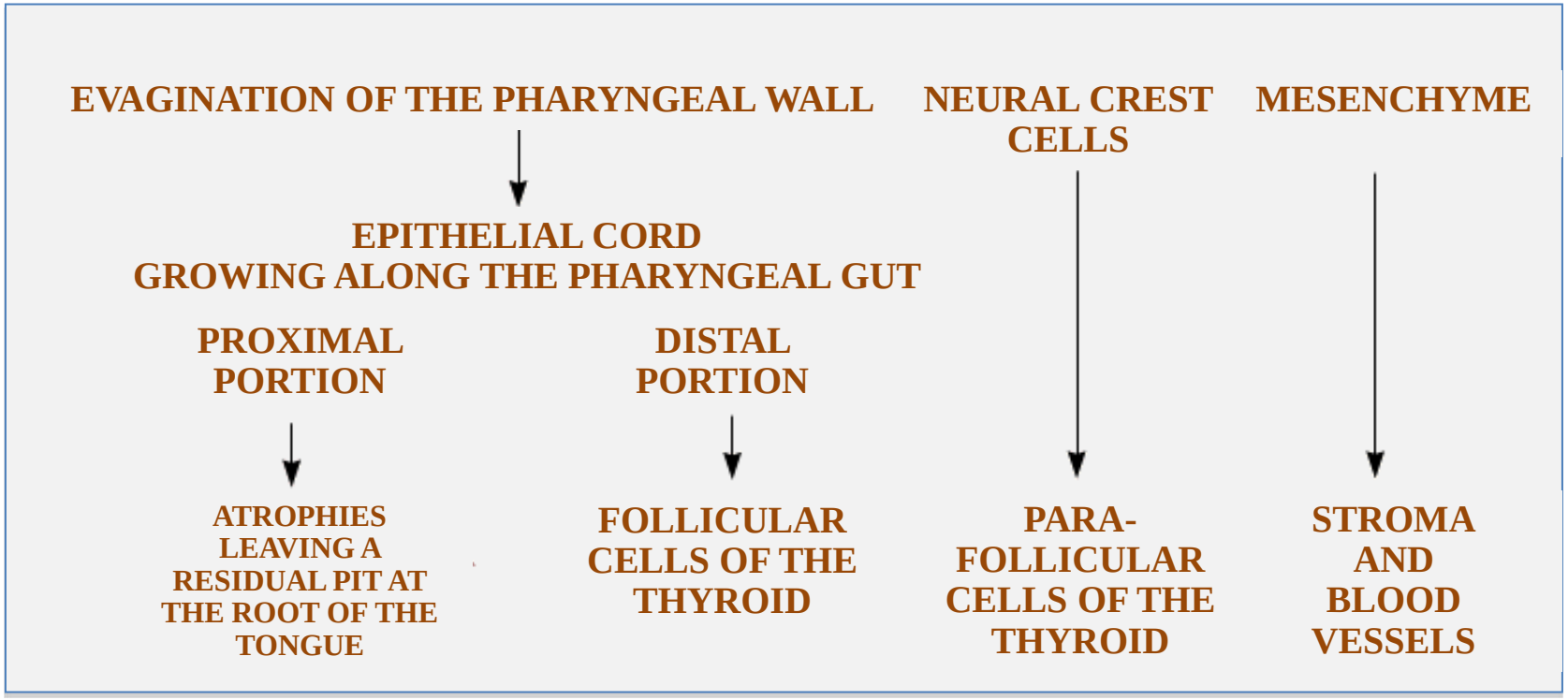
Follicular thyroid cells producing the thyroid hormones T3 and T4

are derived from the pharyngeal wall

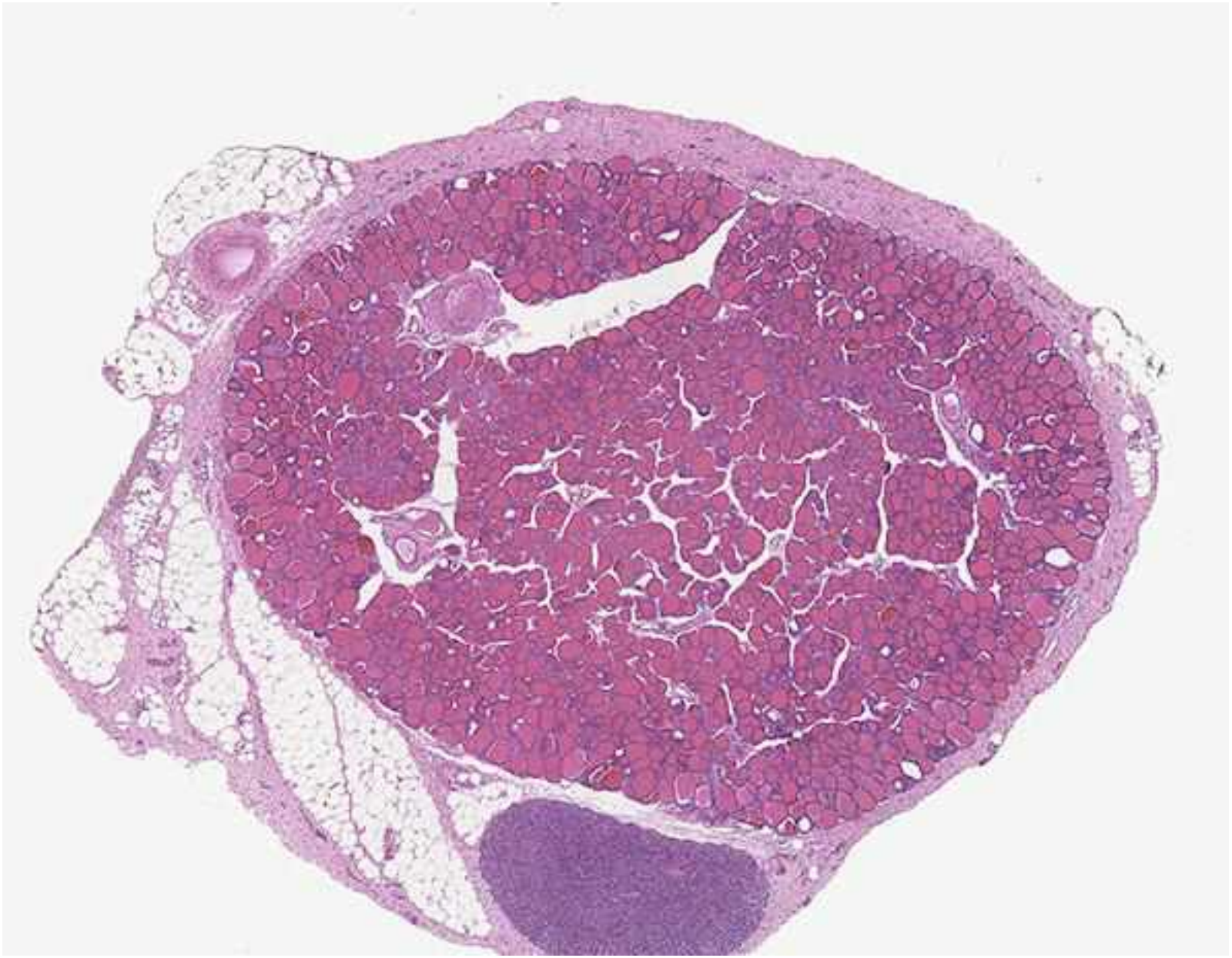
Parafollicular C-cells producing calcitonin

are derived from the neural crest

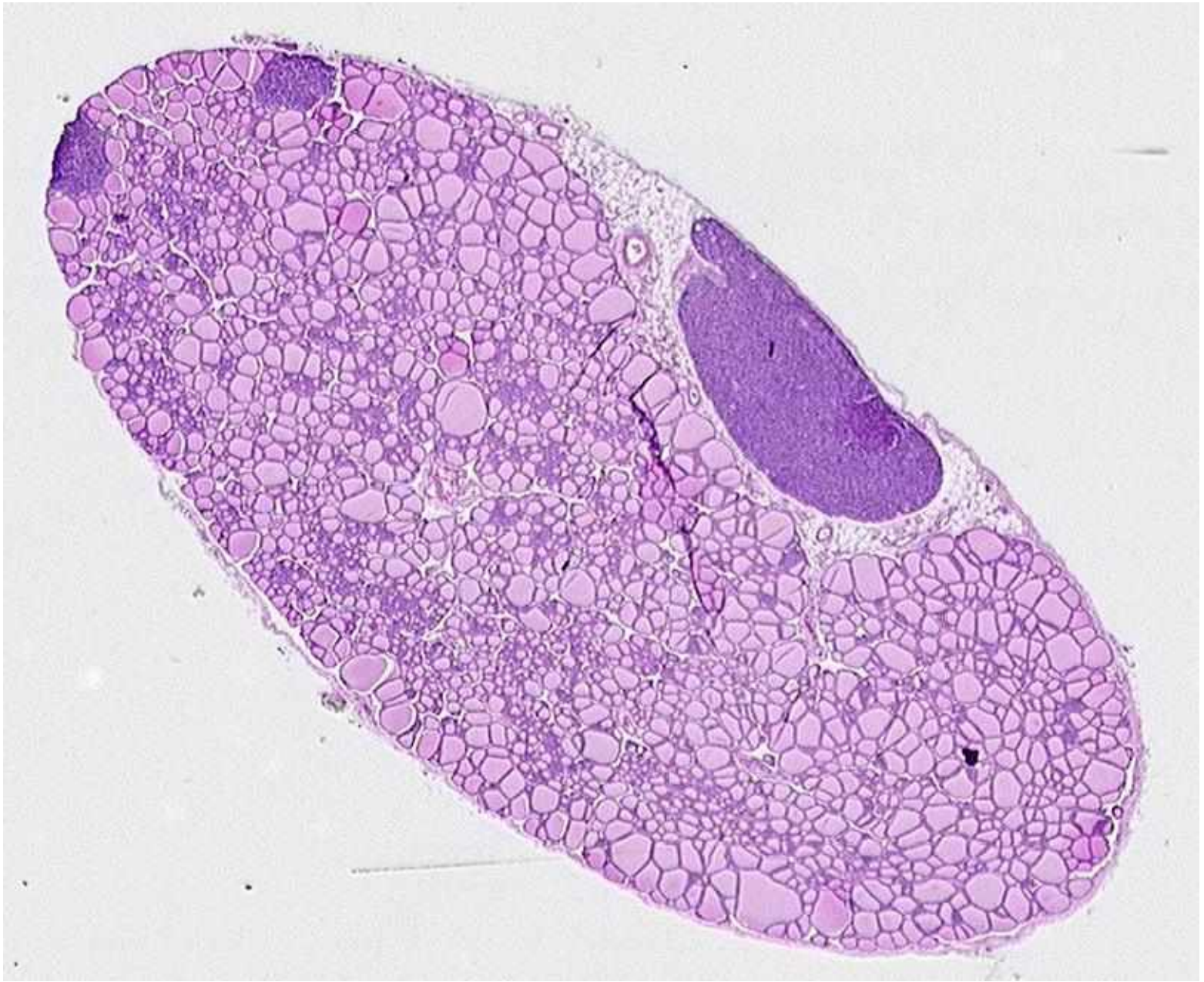
THYROID GLAND DEVELOPMENT



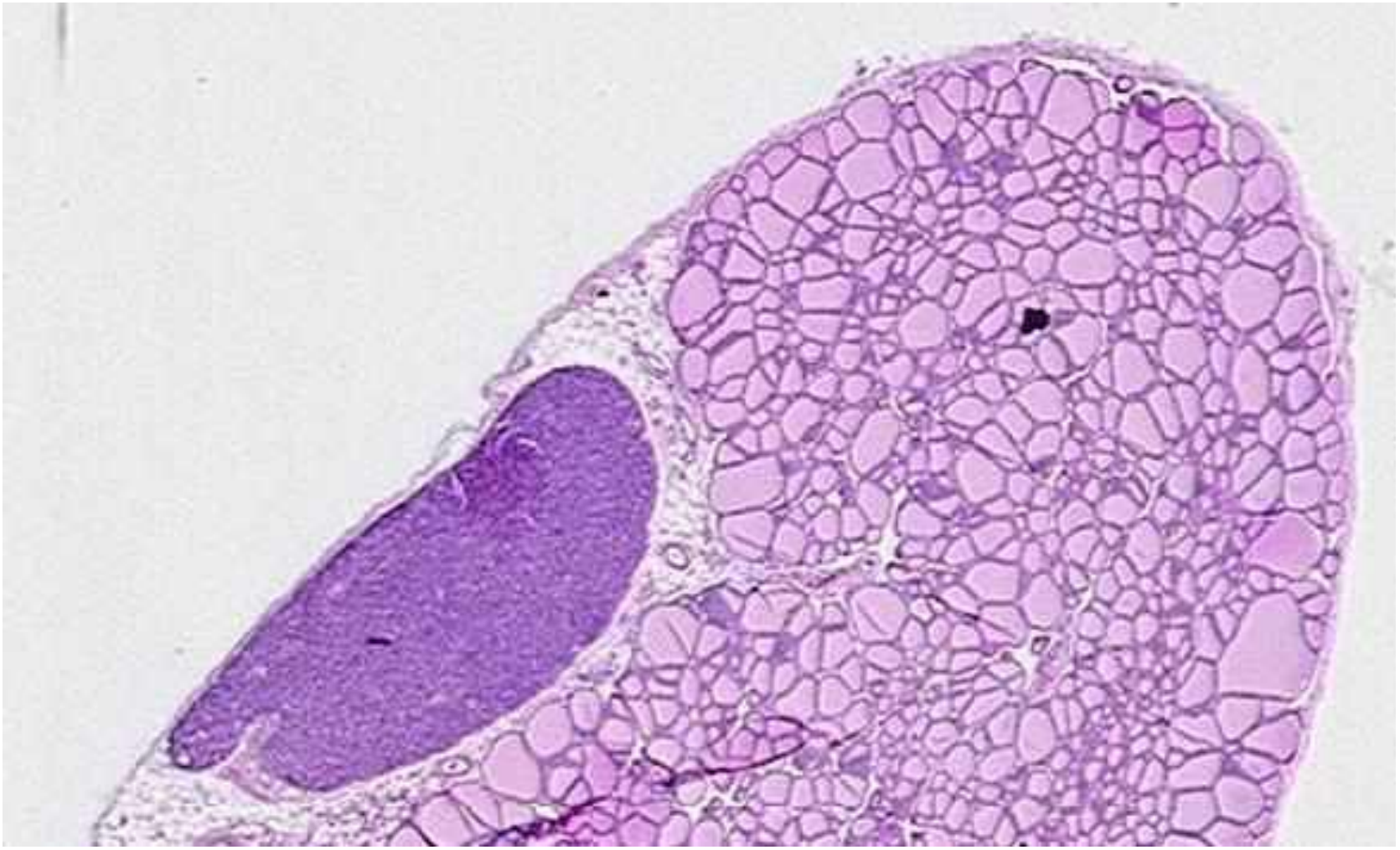
THYROID GLAND *with a portion of the parathyroid gland*



THYROID GLAND *with portions of the parathyroid glands*

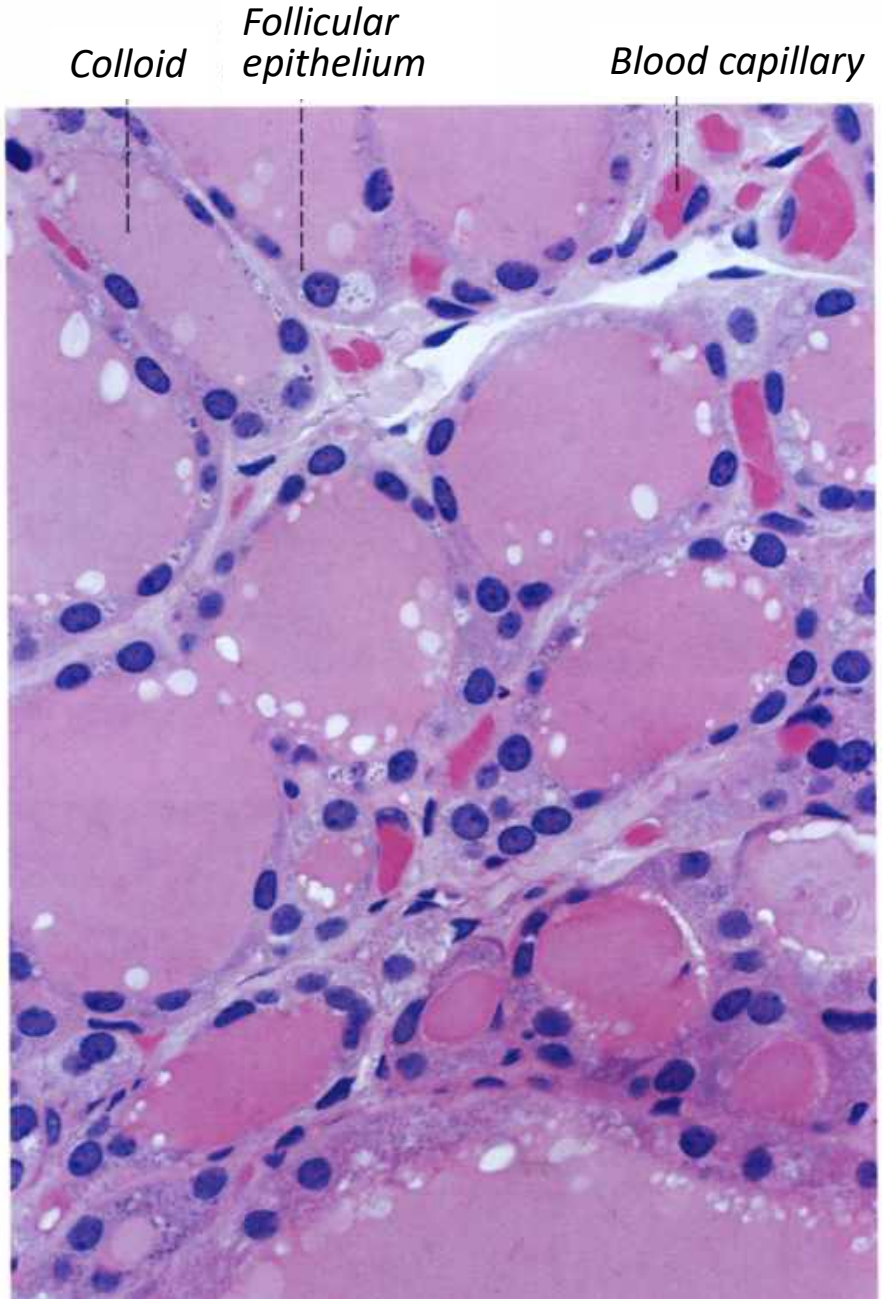


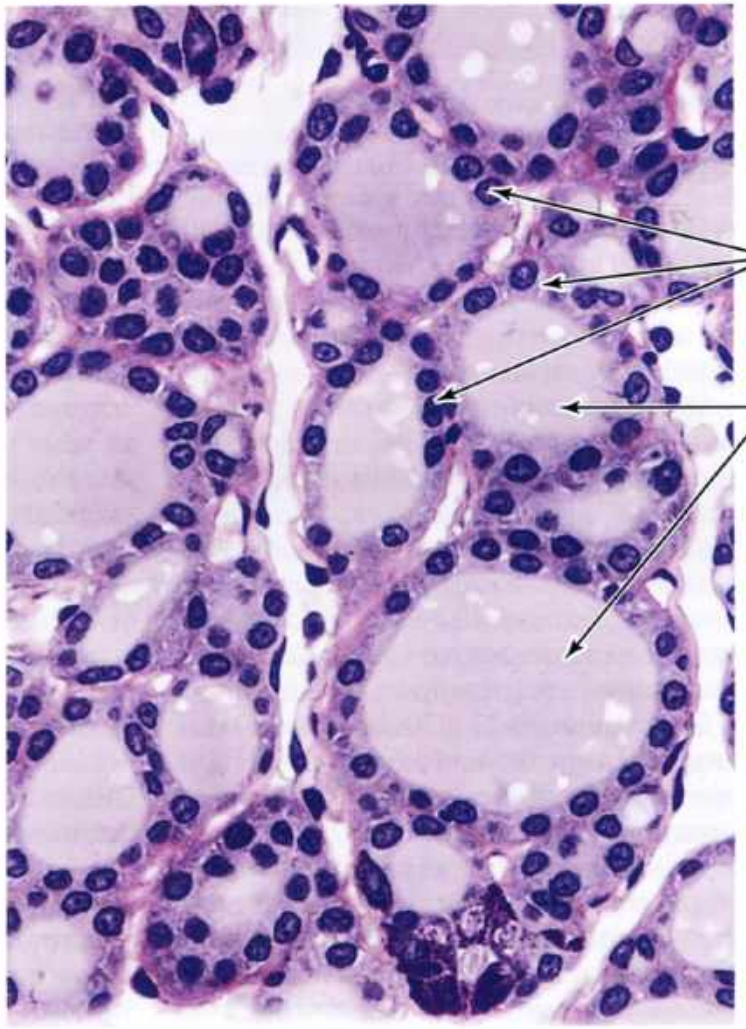
THYROID GLAND *with a portion of the parathyroid gland*



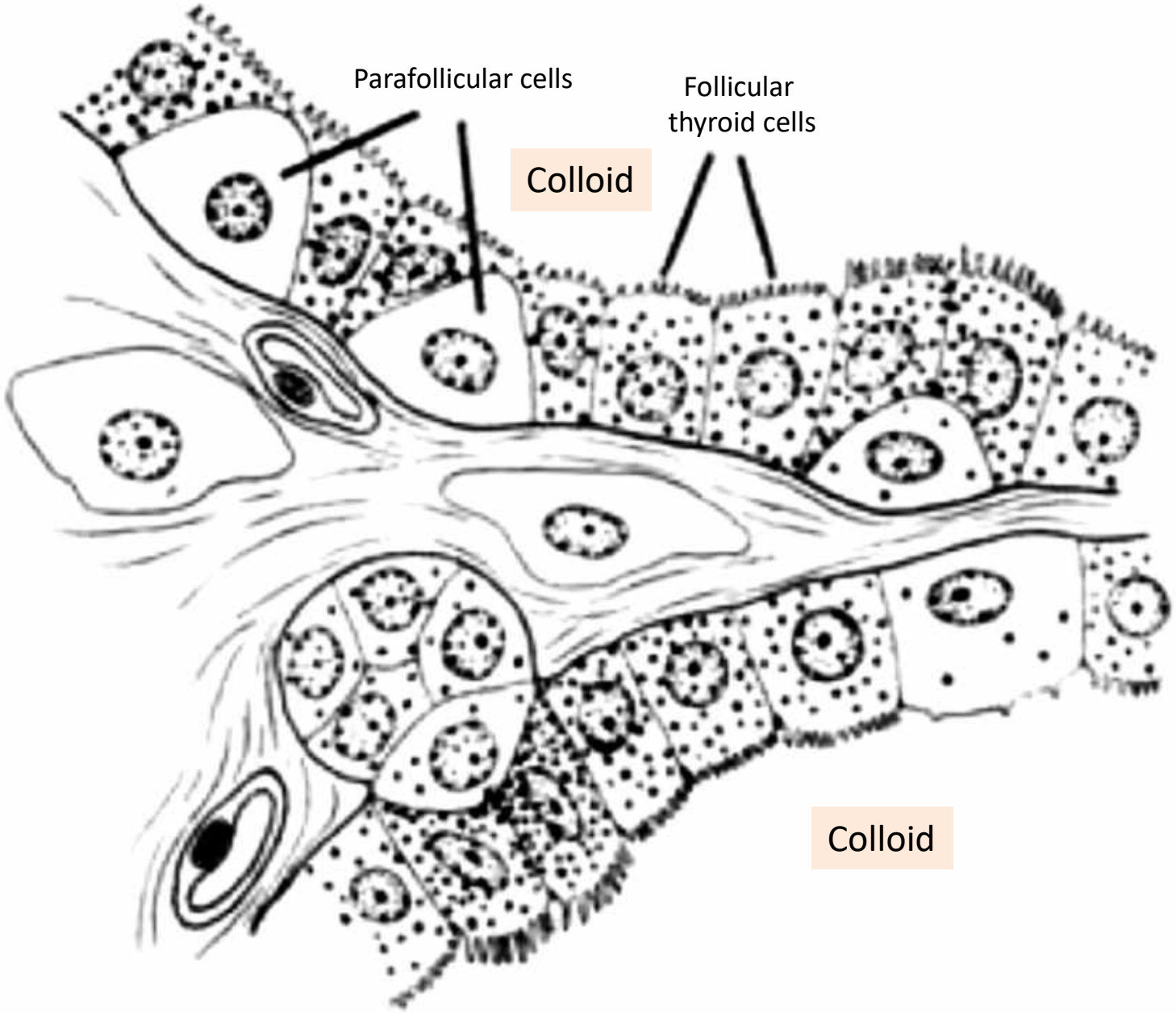
THYROID GLAND *with the parathyroid gland*

STRUCTURE OF THE **THYROID GLAND**





*STRUCTURE OF THE **THYROID** FOLLICLE*



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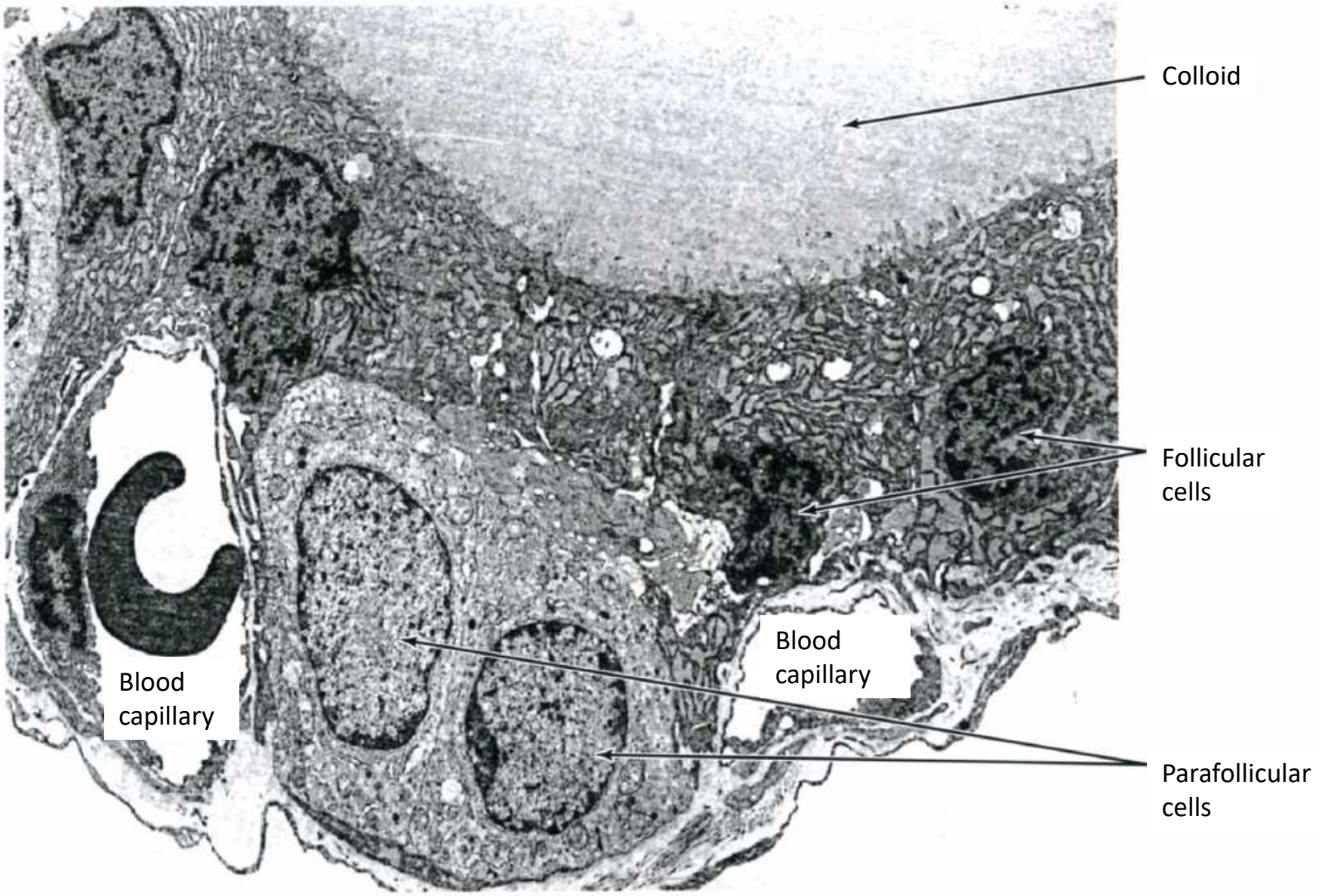
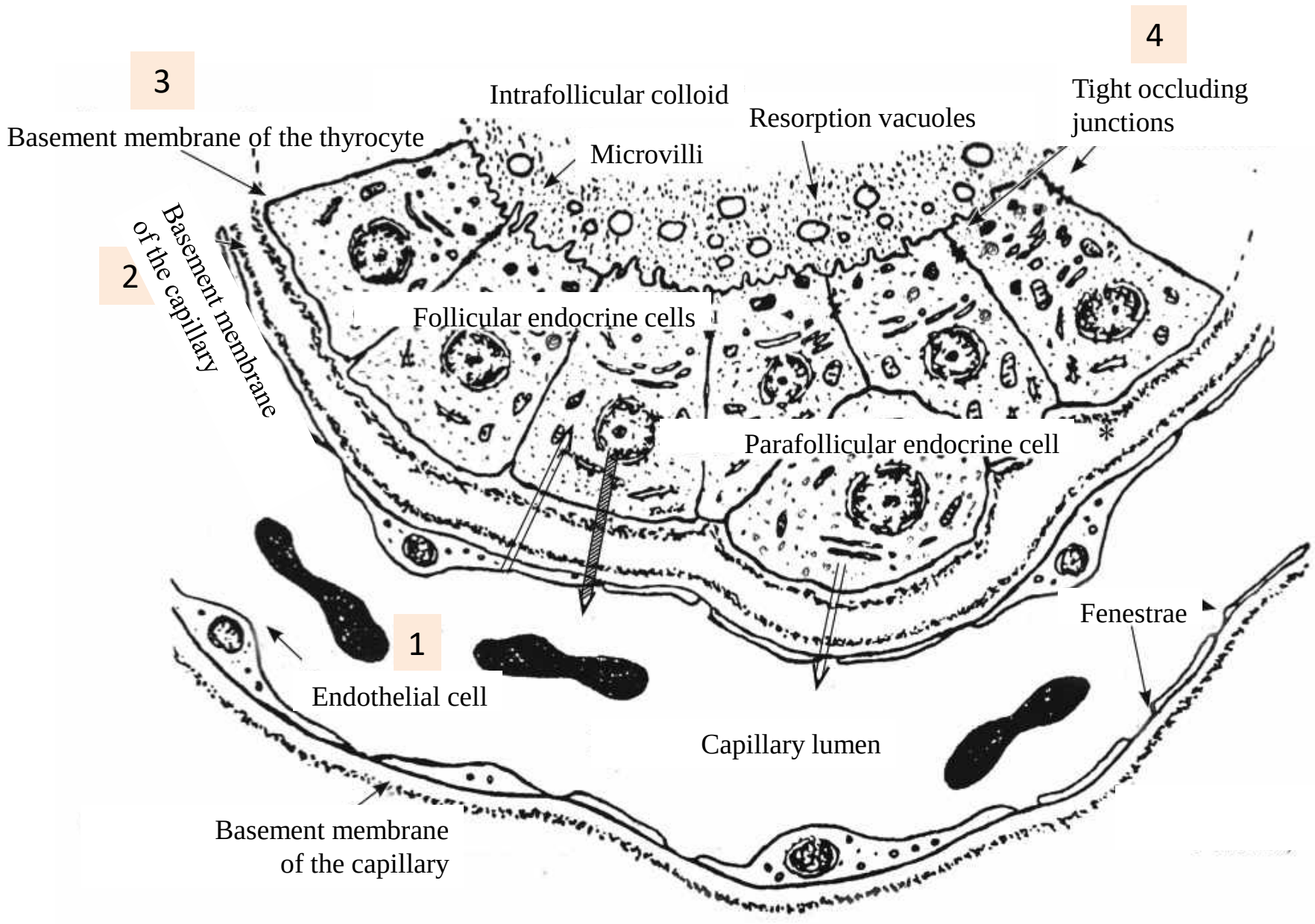
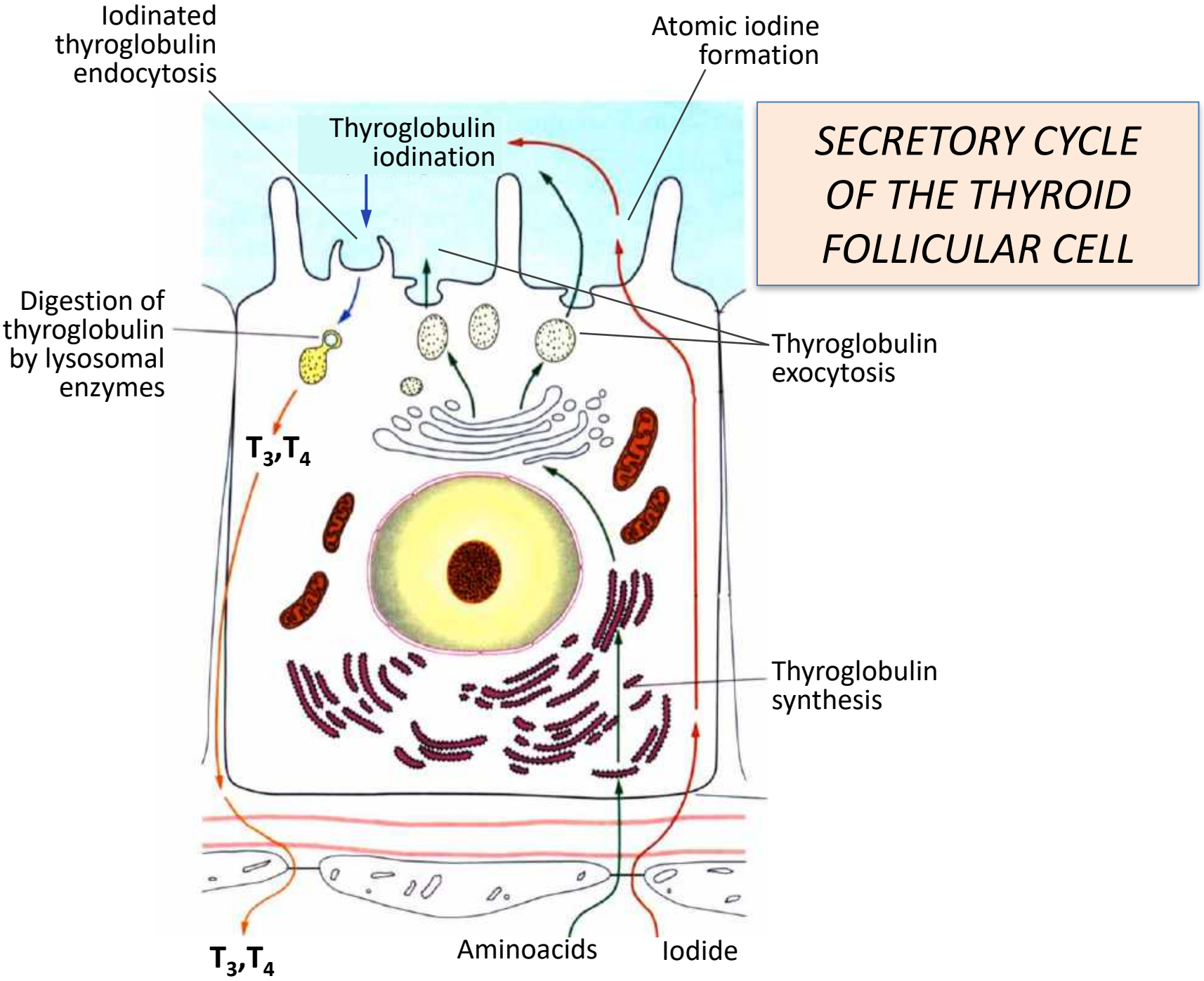
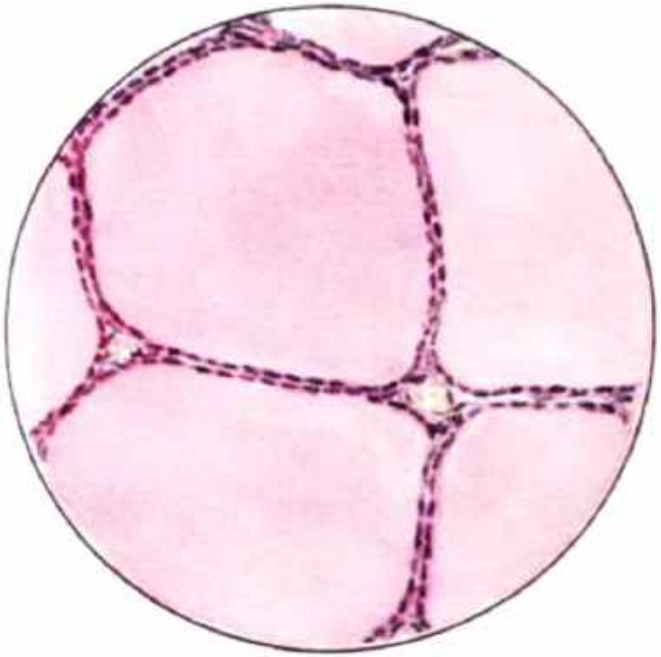


BLOOD-COLLOID BARRIER OF THE THYROID



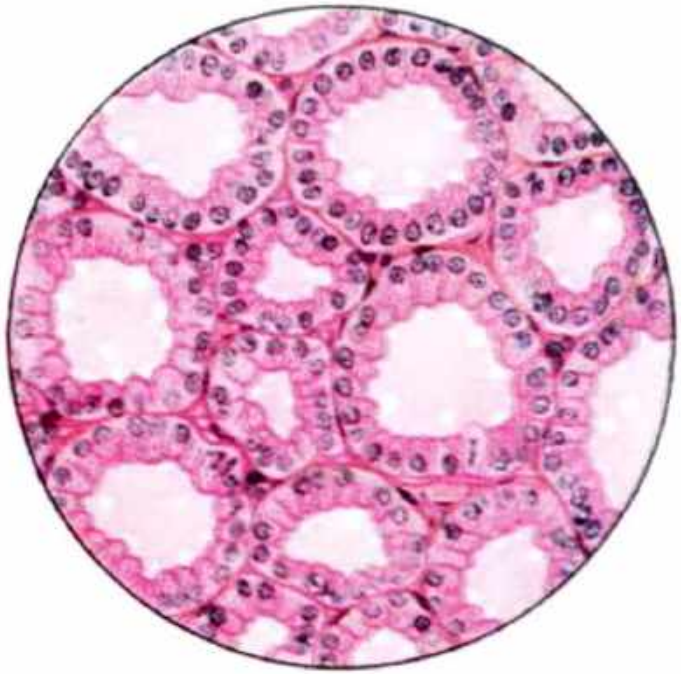

Iodinated thyroglobulin endocytosis
Atomic iodine formation
Thyroglobulin iodination
SECRETORY CYCLE OF THE THYROID FOLLICULAR CELL
Digestion of thyroglobulin by lysosomal enzymes
Thyroglobulin exocytosis
T3,T4
Thyroglobulin synthesis
T3,T4
Aminoacids
Iodide

THYROID HYPOFUNCTION



Follicular cells decrease in volume and become squamous, the density of their apical microvilli decreases; the follicle volume increases; the colloid thickens, and the resorption vacuoles become inconspicuous; mitotic activity of the follicular cells decreases

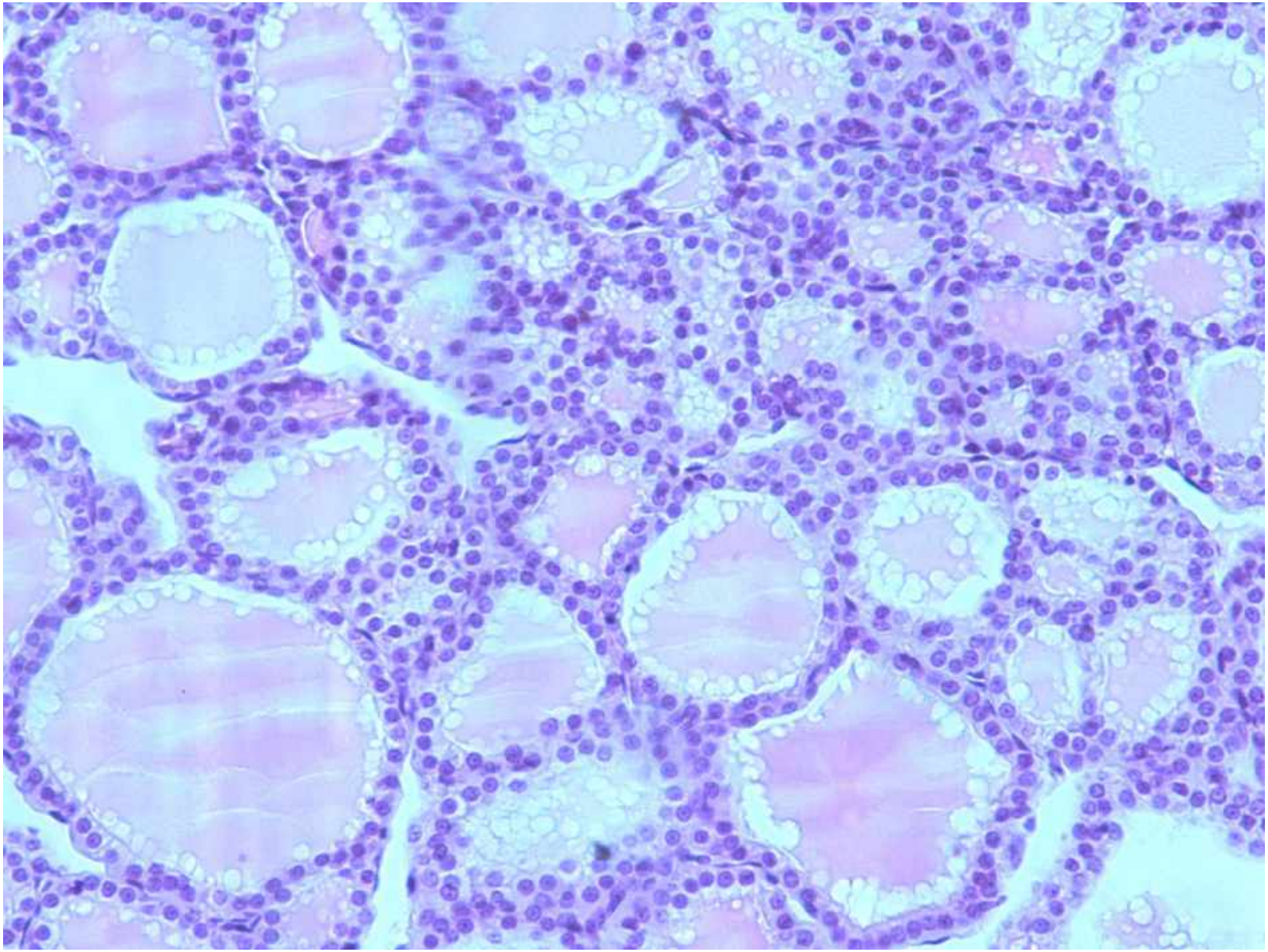
THYROID HYPERFUNCTION



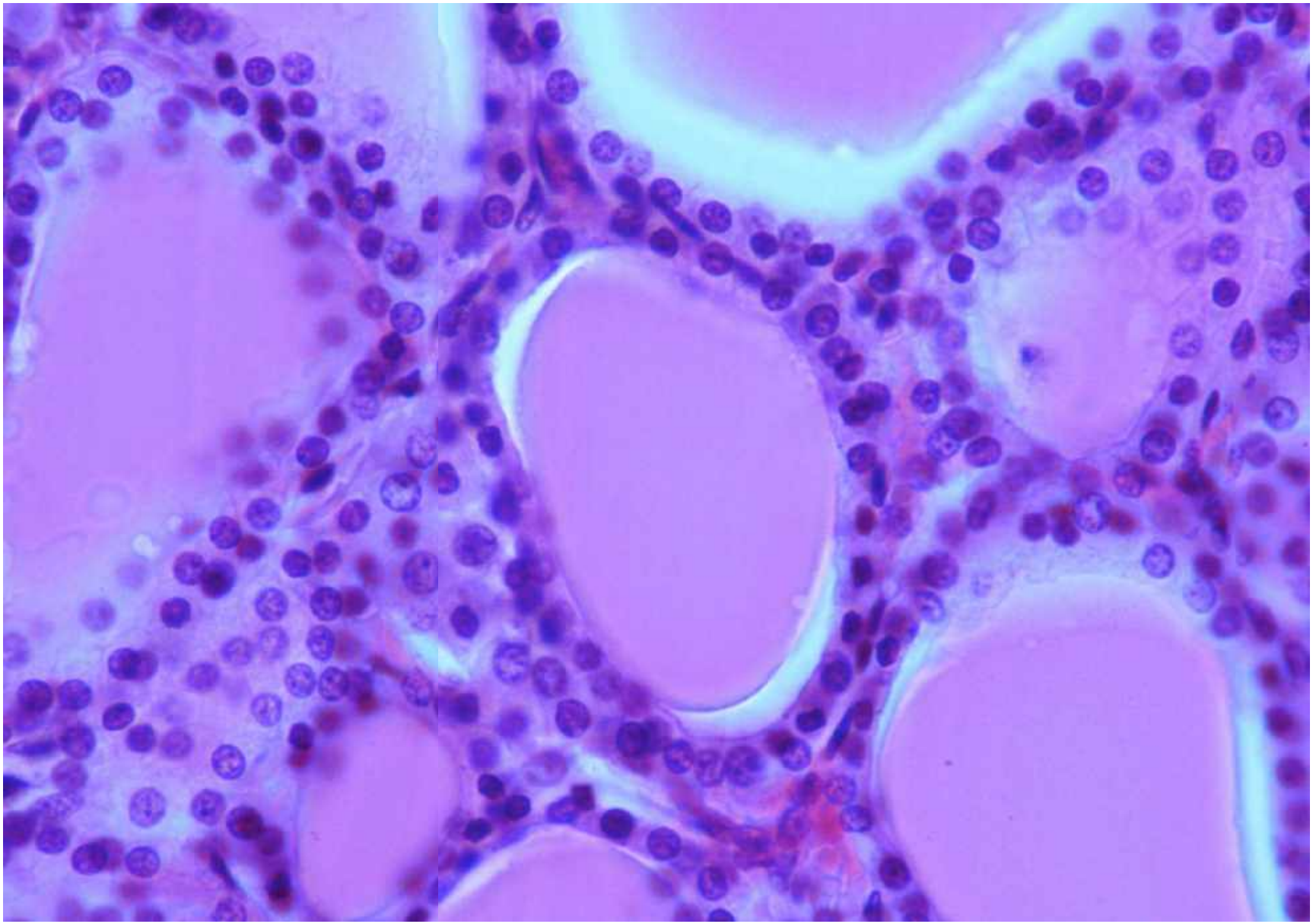
Follicular cells increase in volume and become columnar, the density of microvilli on their apical surfaces increases; volumes of the colloid and the follicles decrease; resorption vacuoles are prominent; mitotic activity of the follicular cells increases

*Slide №110 "*Thyroid gland, H&E"

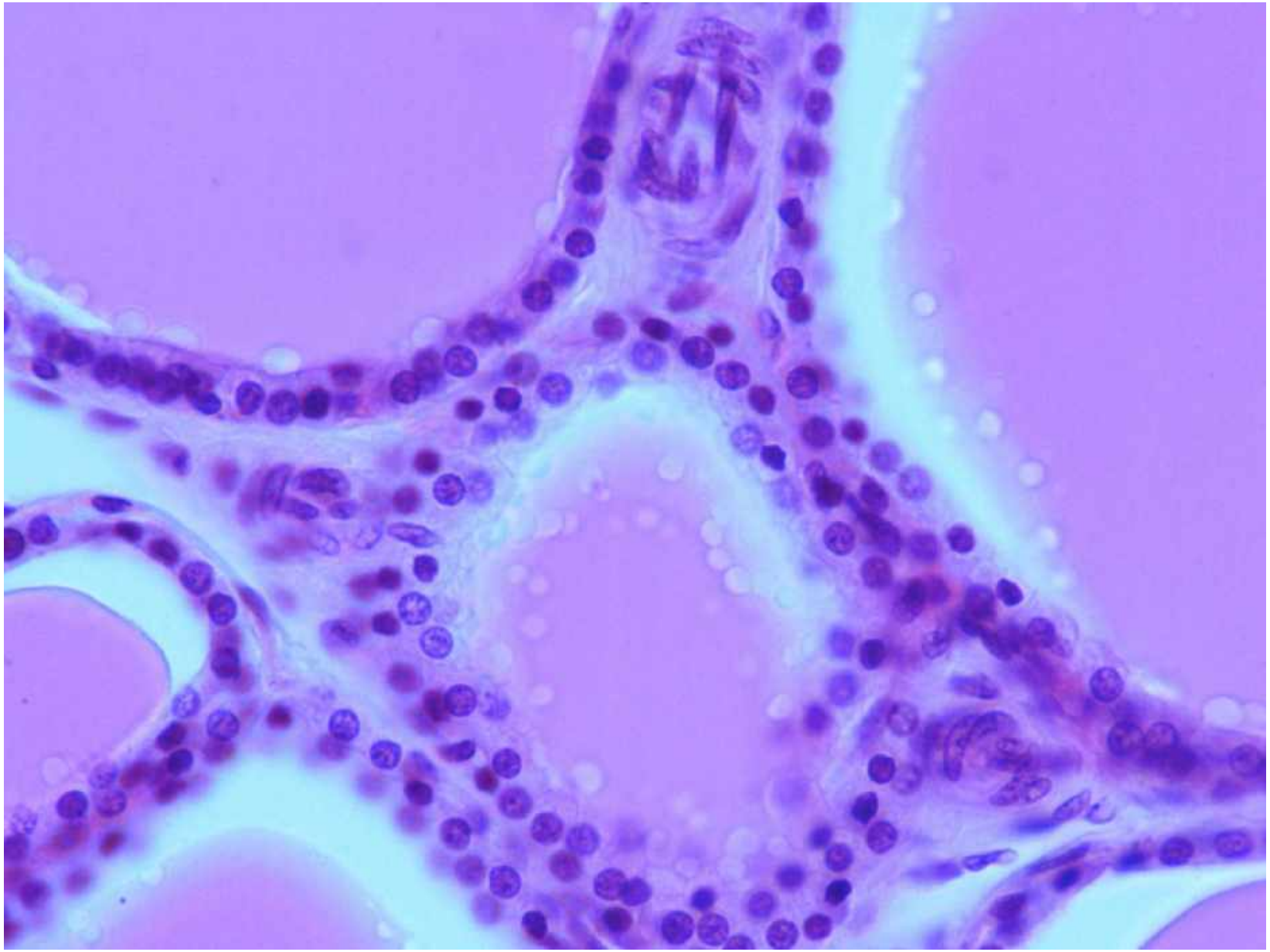
*Slide №110 "*Thyroid gland, H&E"



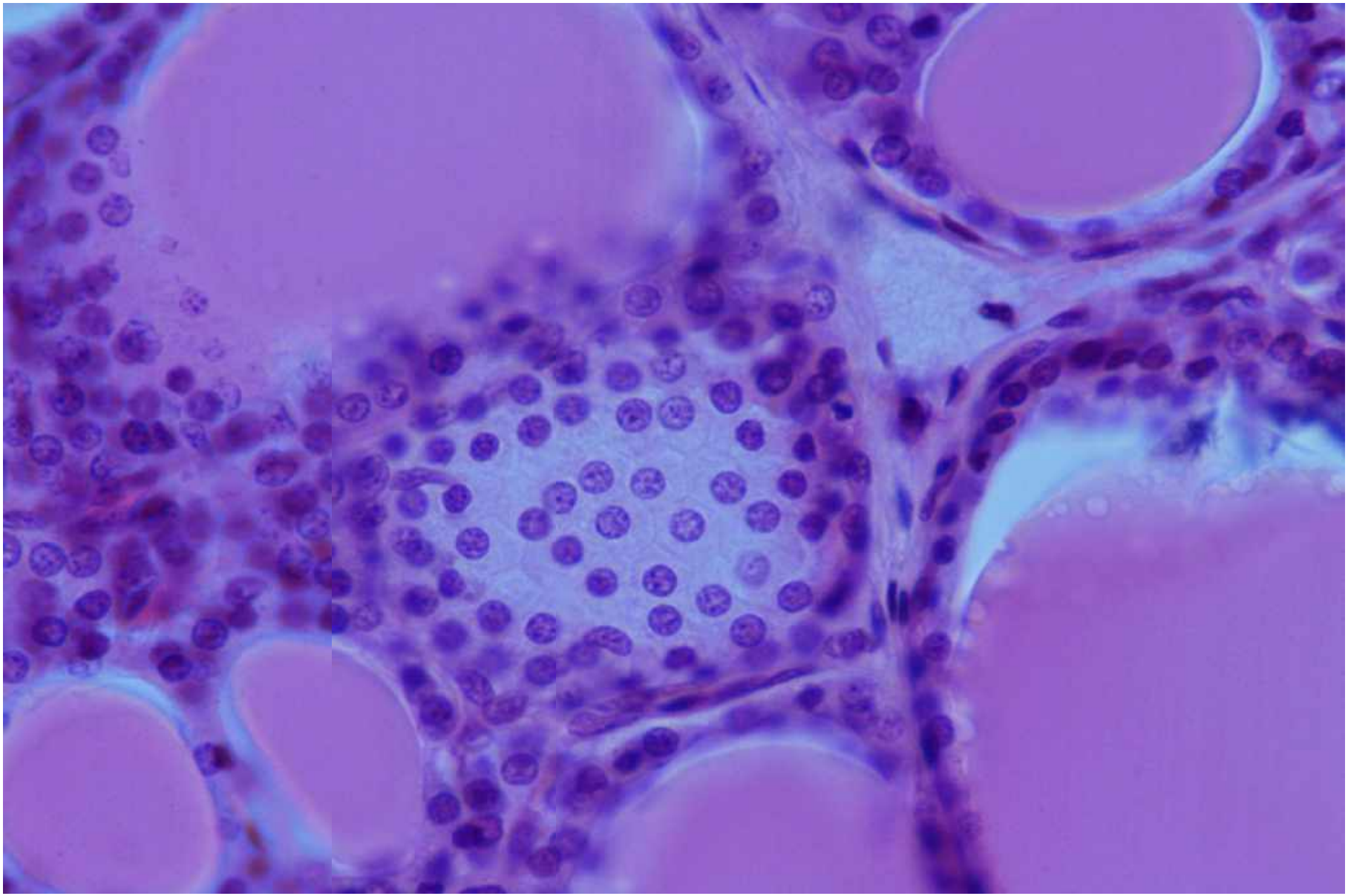
Slide №110 “Thyroid gland, H&E”



*Slide №110 "*Thyroid gland, H&E"

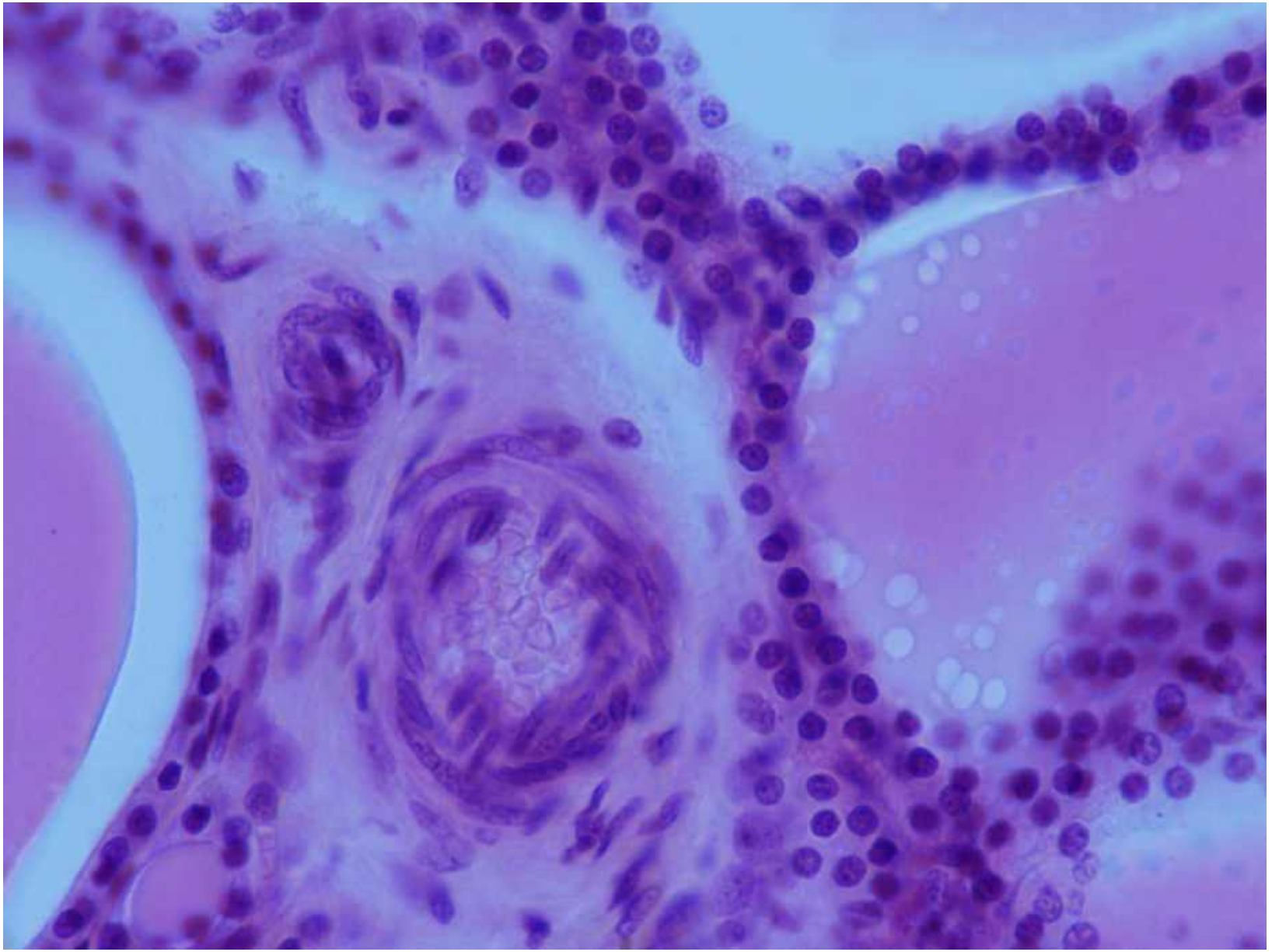


*Slide №110 "*Thyroid gland, H&E"

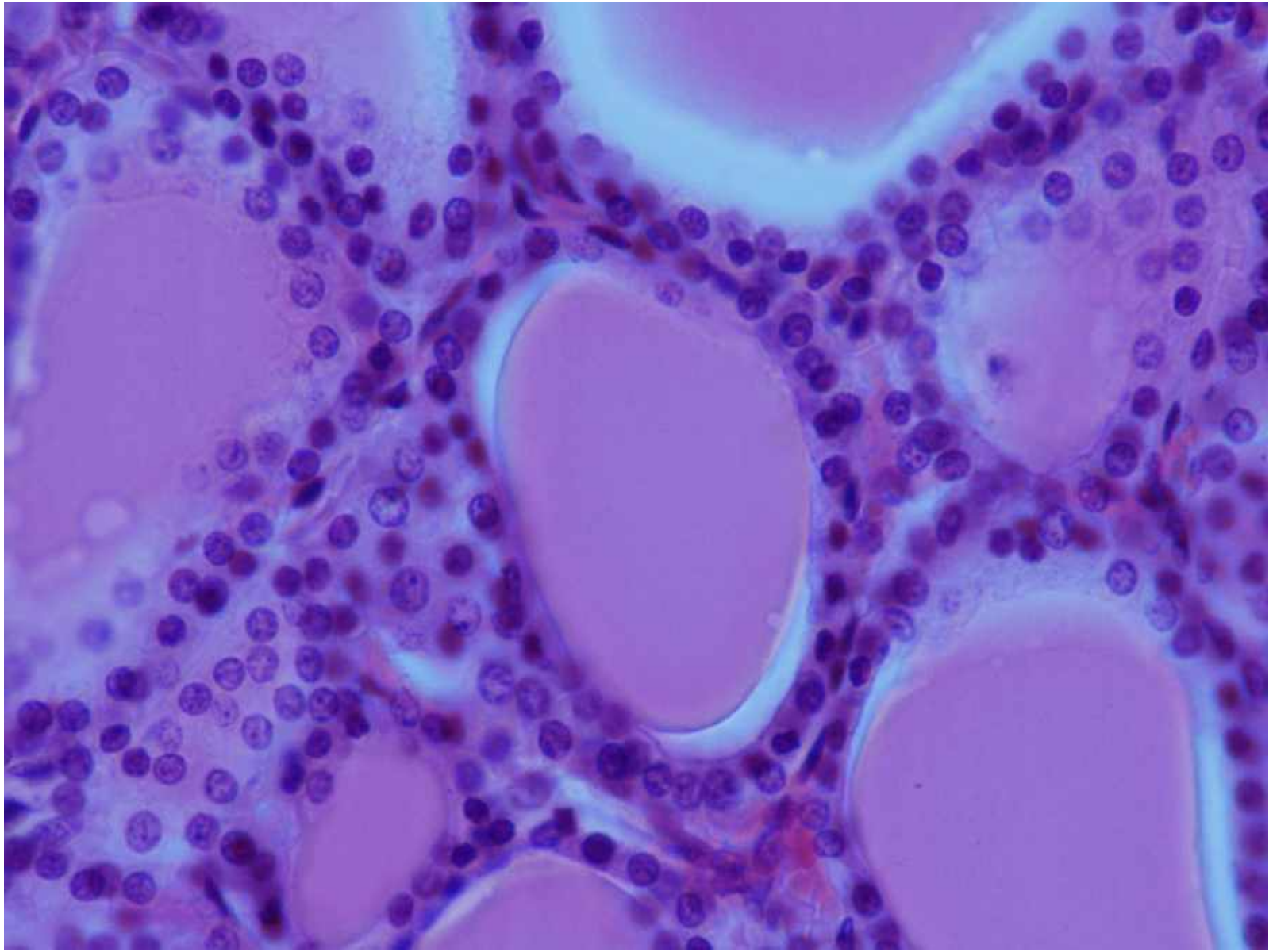


*Slide №110 "*Thyroid gland, H&E"

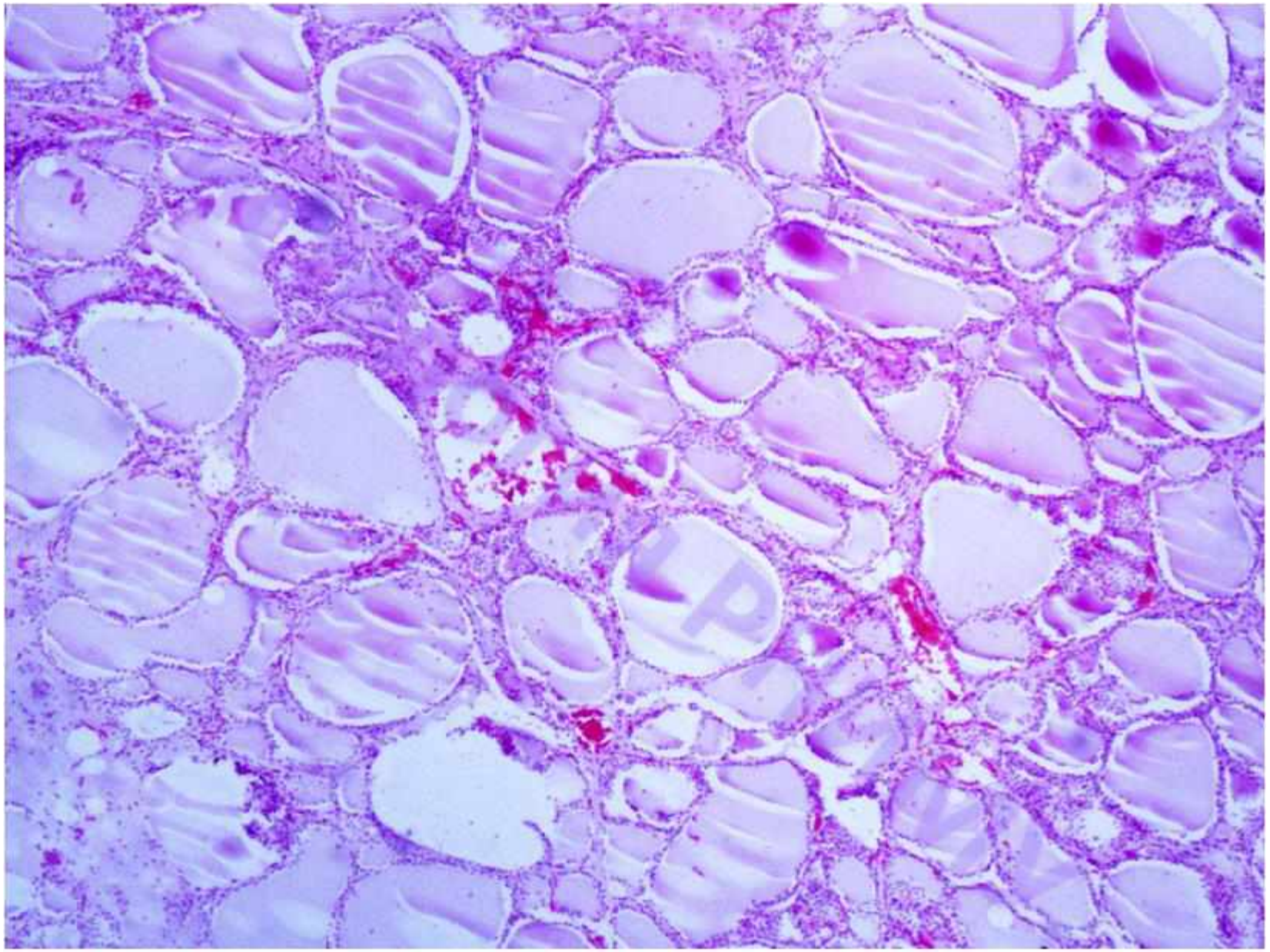
*Slide №110 "*Thyroid gland, H&E"



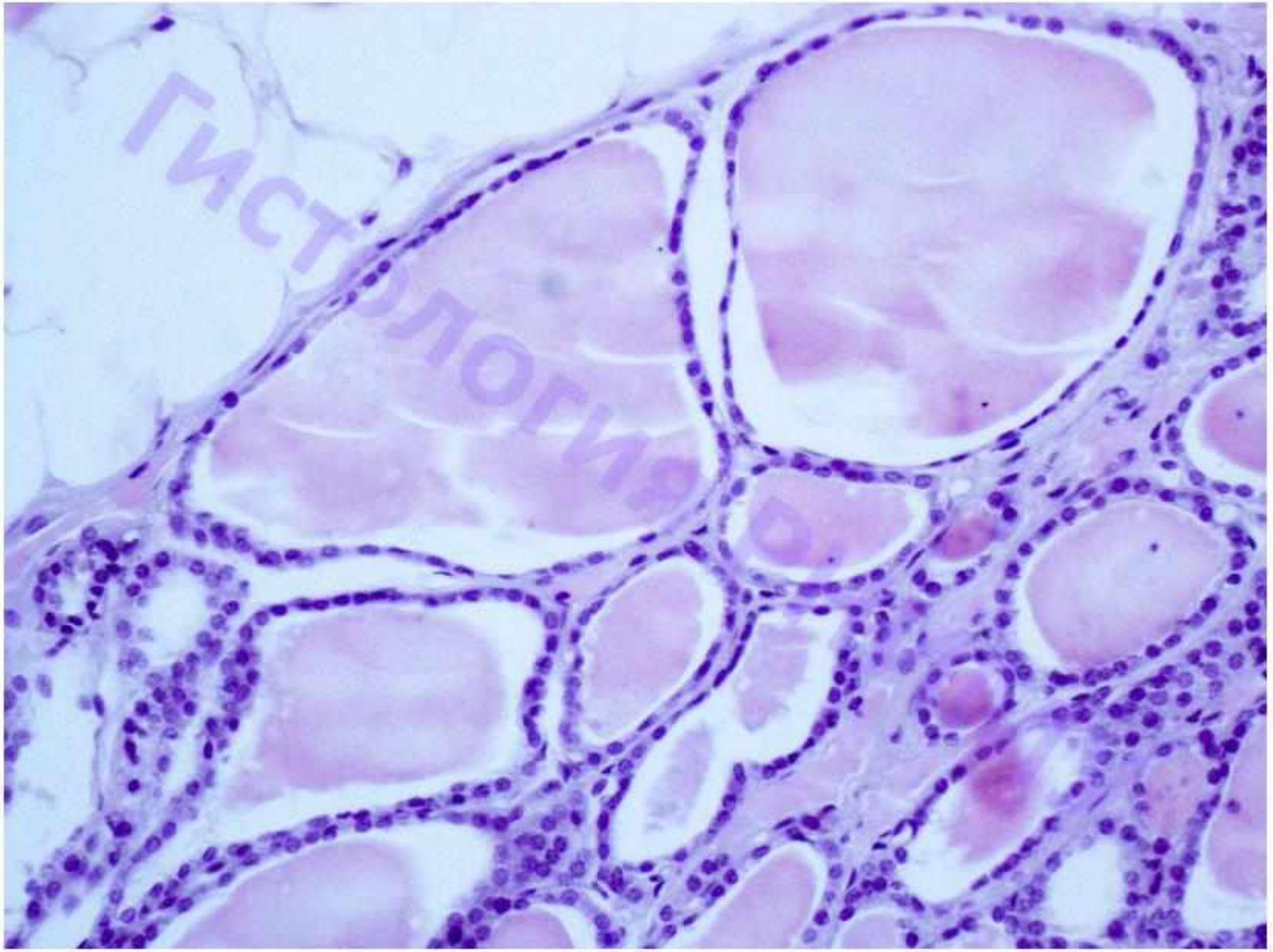
Slide №110 “Thyroid gland, H&E”



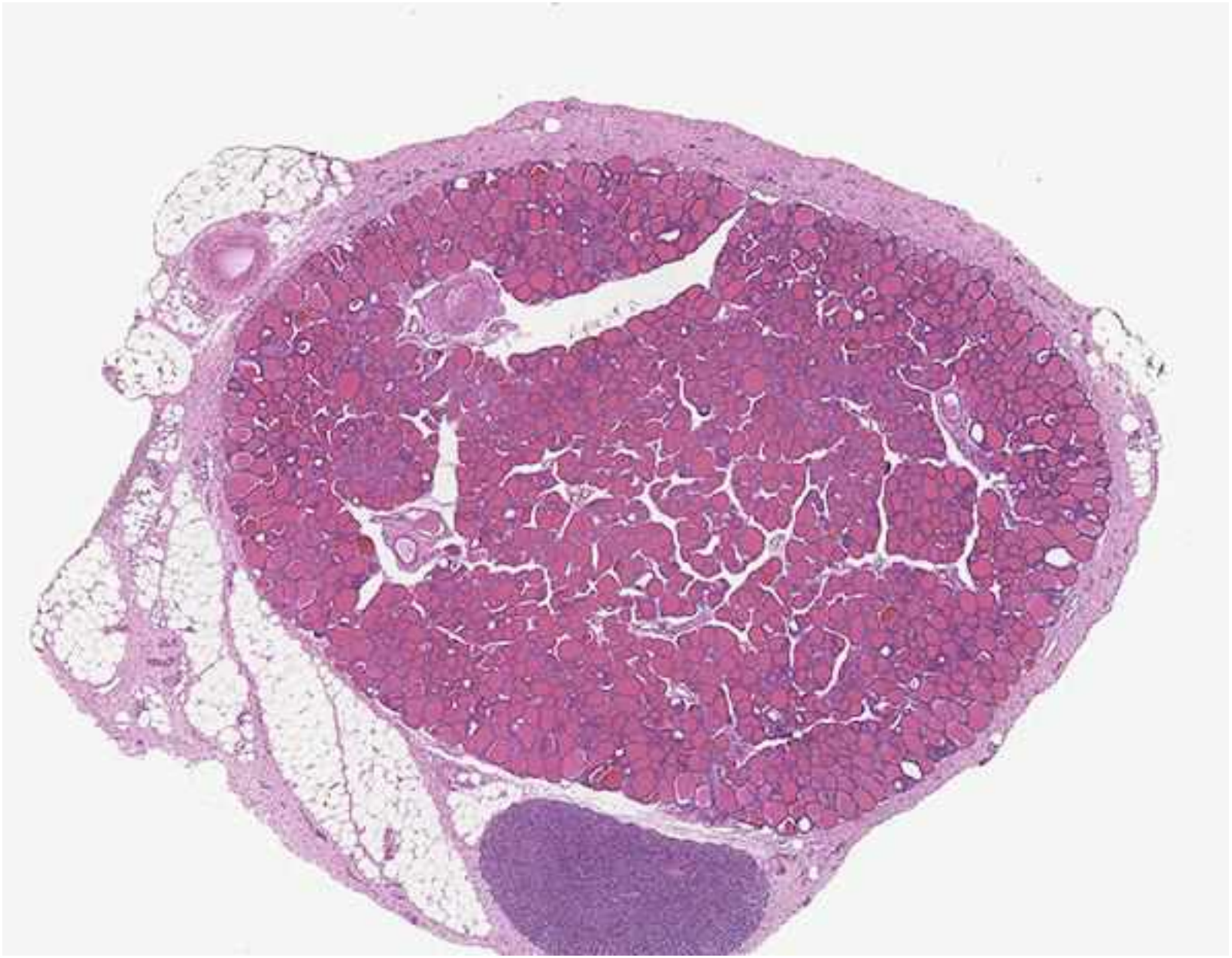
Slide №110a "Thyroid gland in hypofunction, H&E"



Slide №110a "Thyroid gland in hypofunction, H&E"

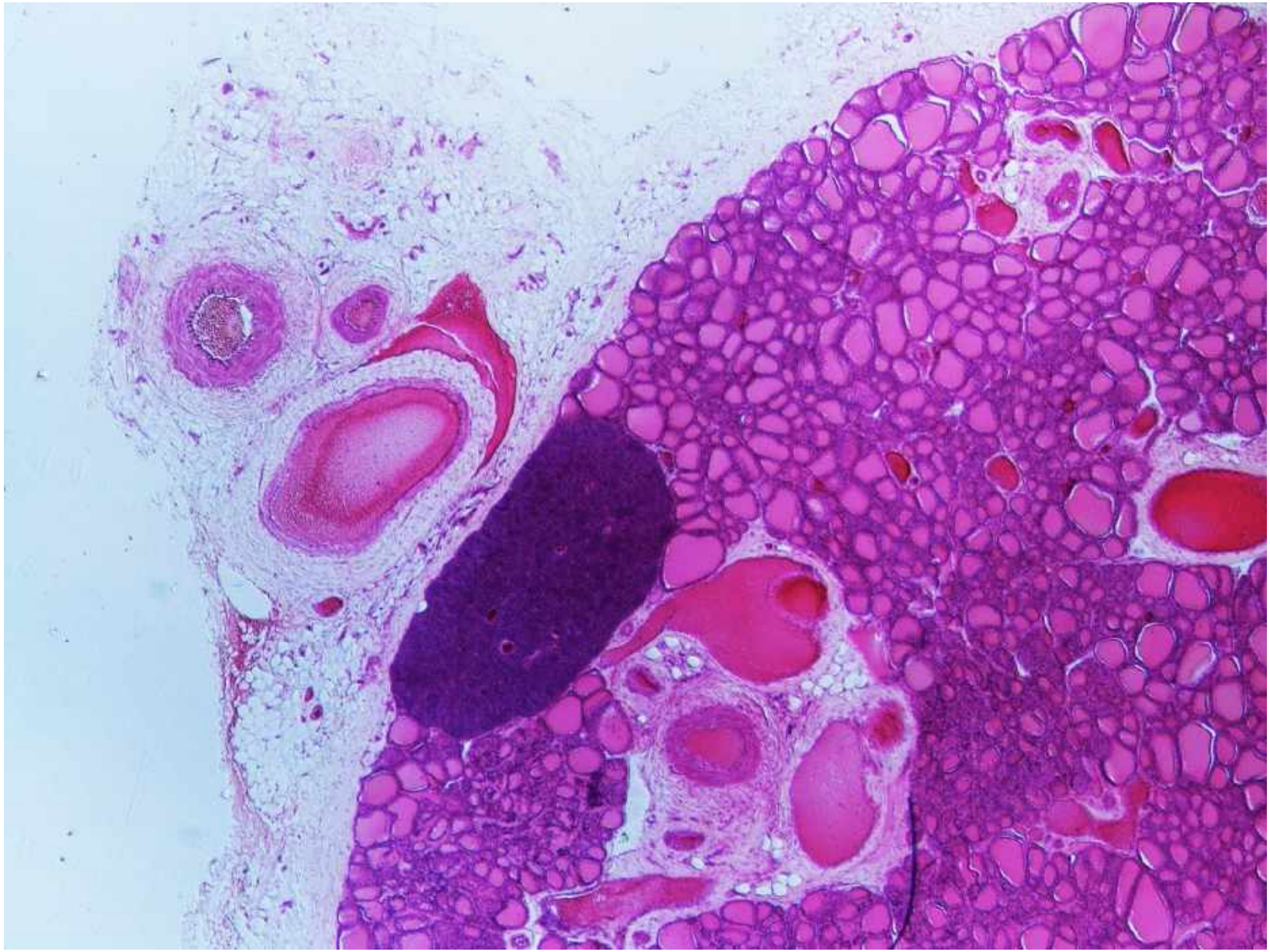


PARATHYROID GLANDS *with the thyroid gland*

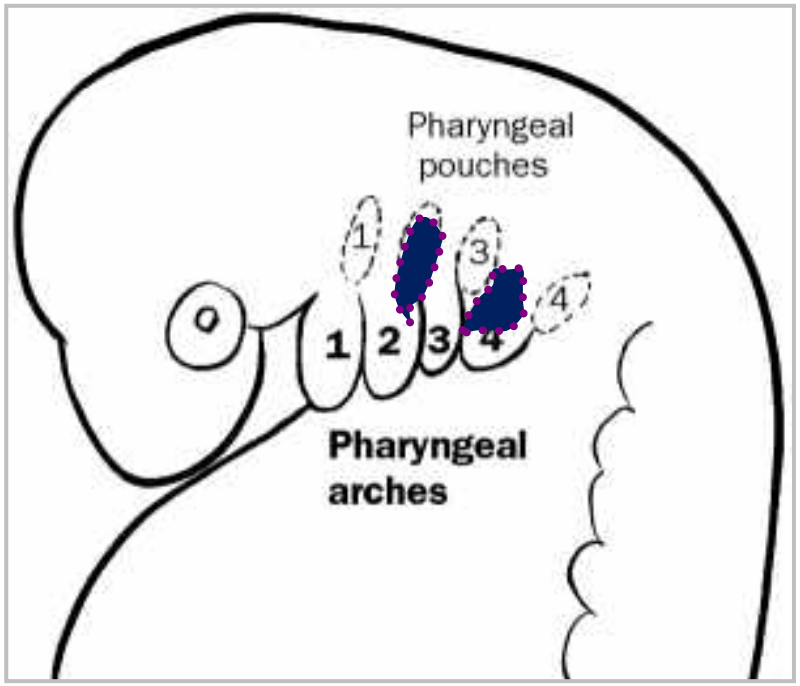


PARATHYROID GLANDS *with the thyroid gland*

PARATHYROID GLANDS *with the thyroid gland*



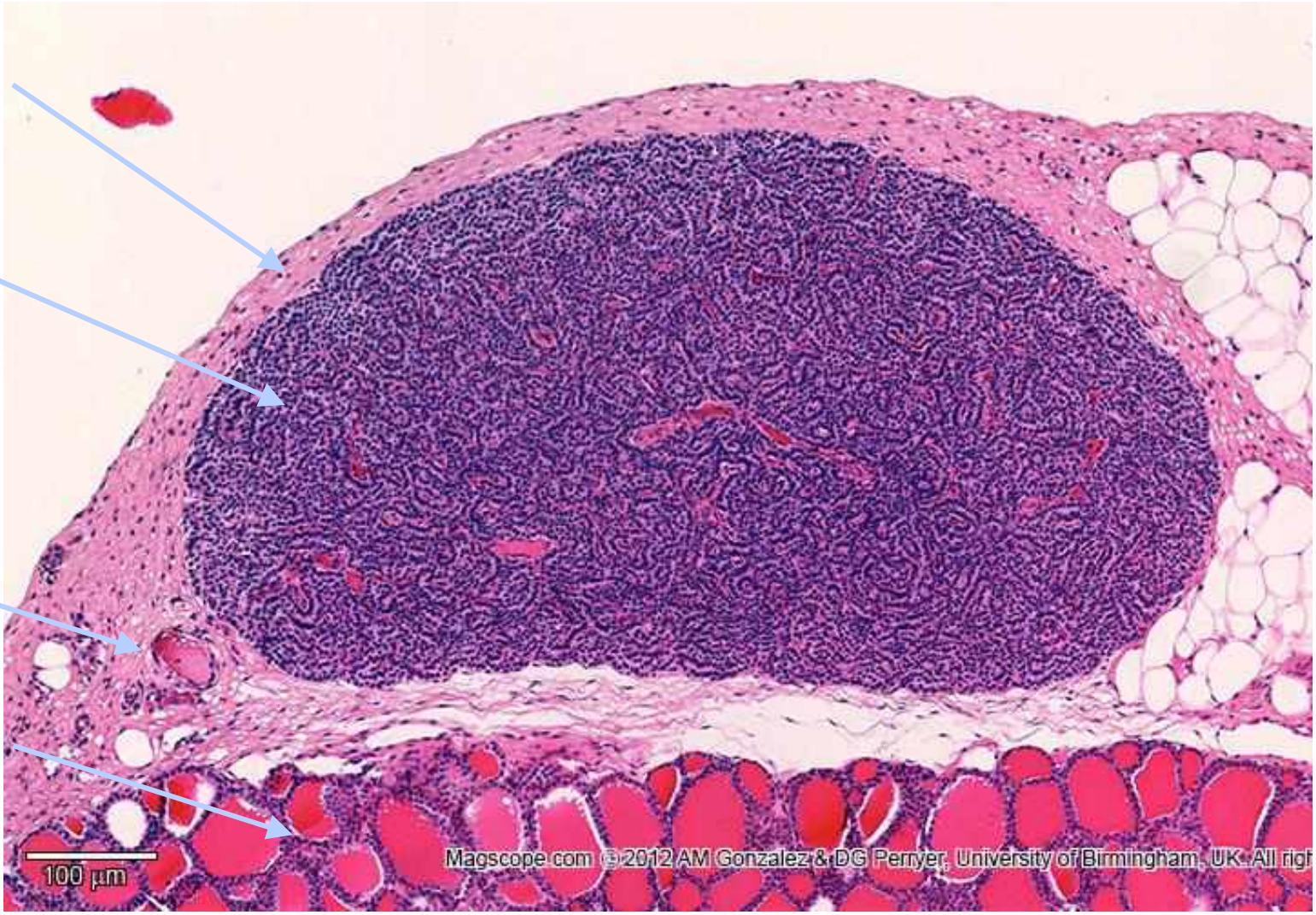
PARATHYROID GLANDS *DEVELOPMENT*



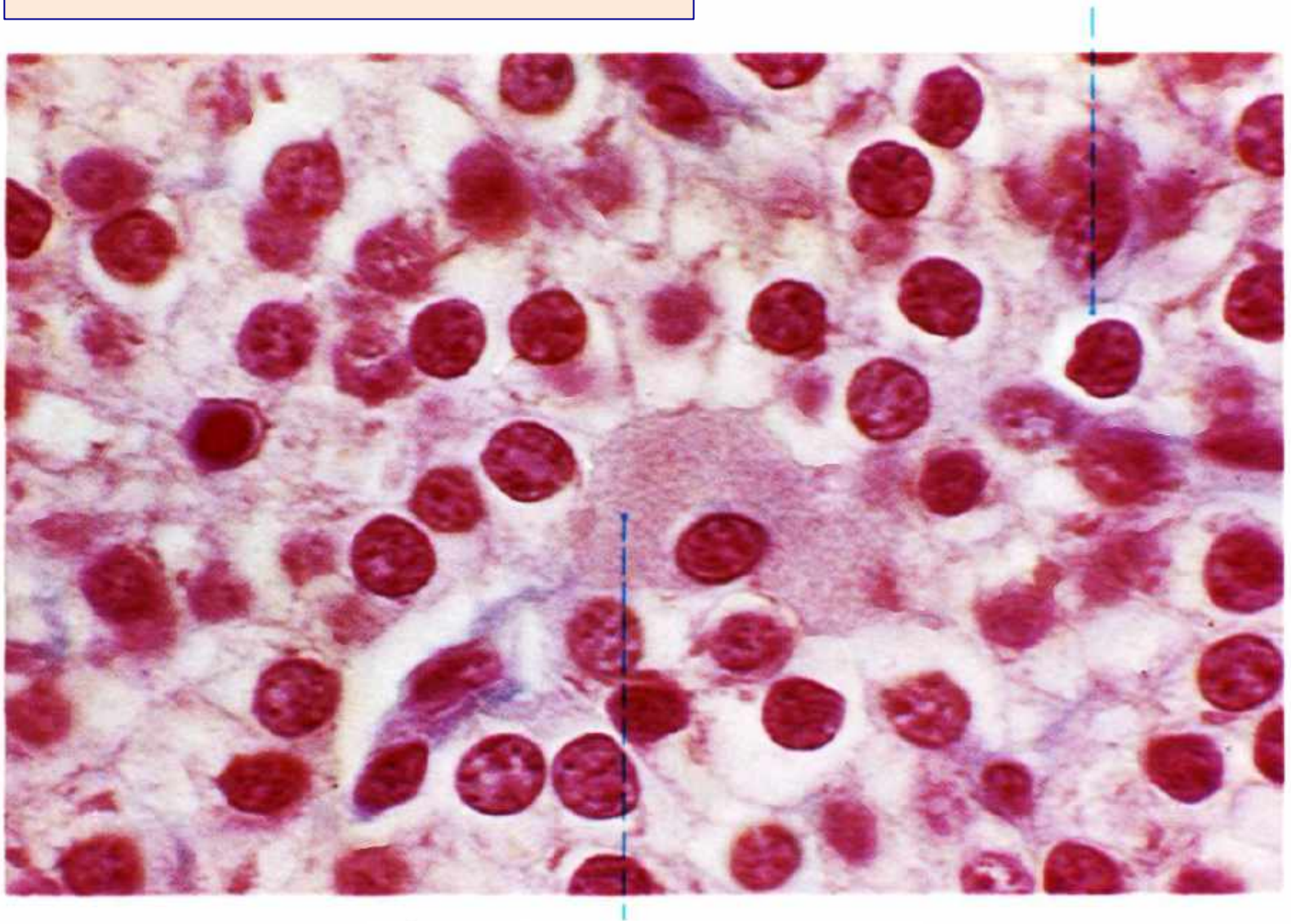
Epithelium of the pharyngeal pouches sinks into the underlying mesenchyme

Pairs III and IV of pharyngeal pouches give rise to the two pairs of parathyroid glands

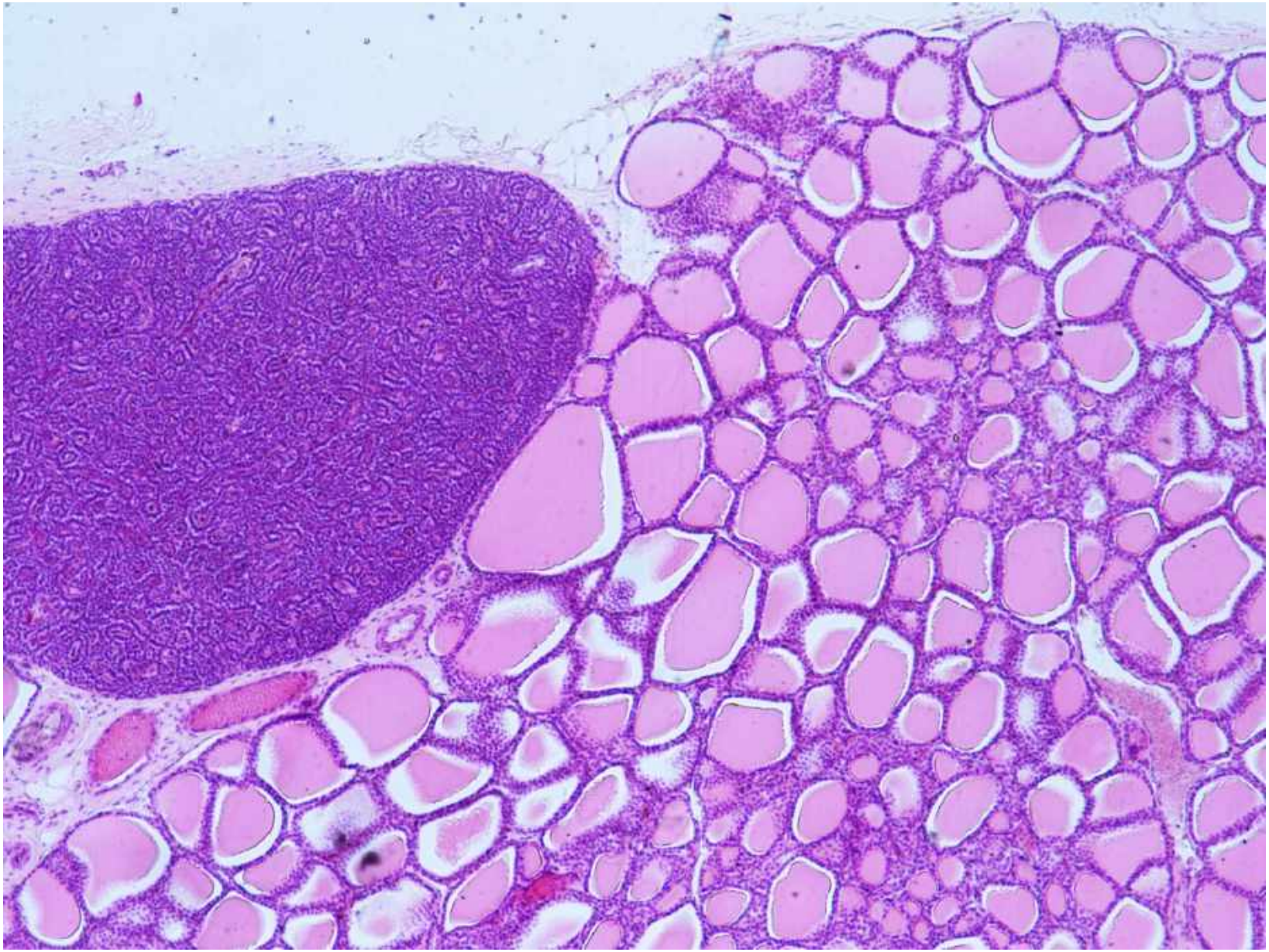
PARATHYROID GLAND



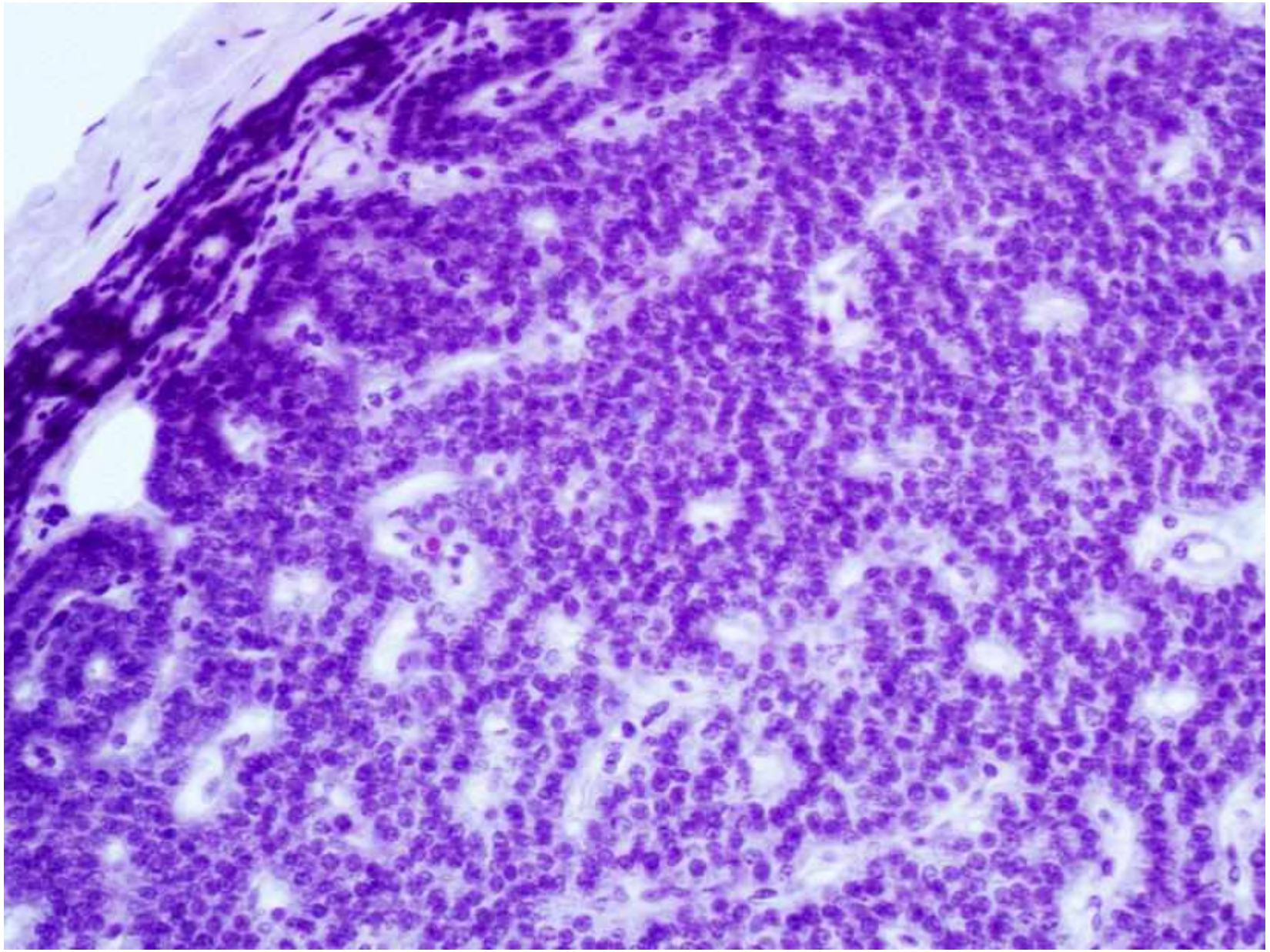
PARATHYROID GLAND



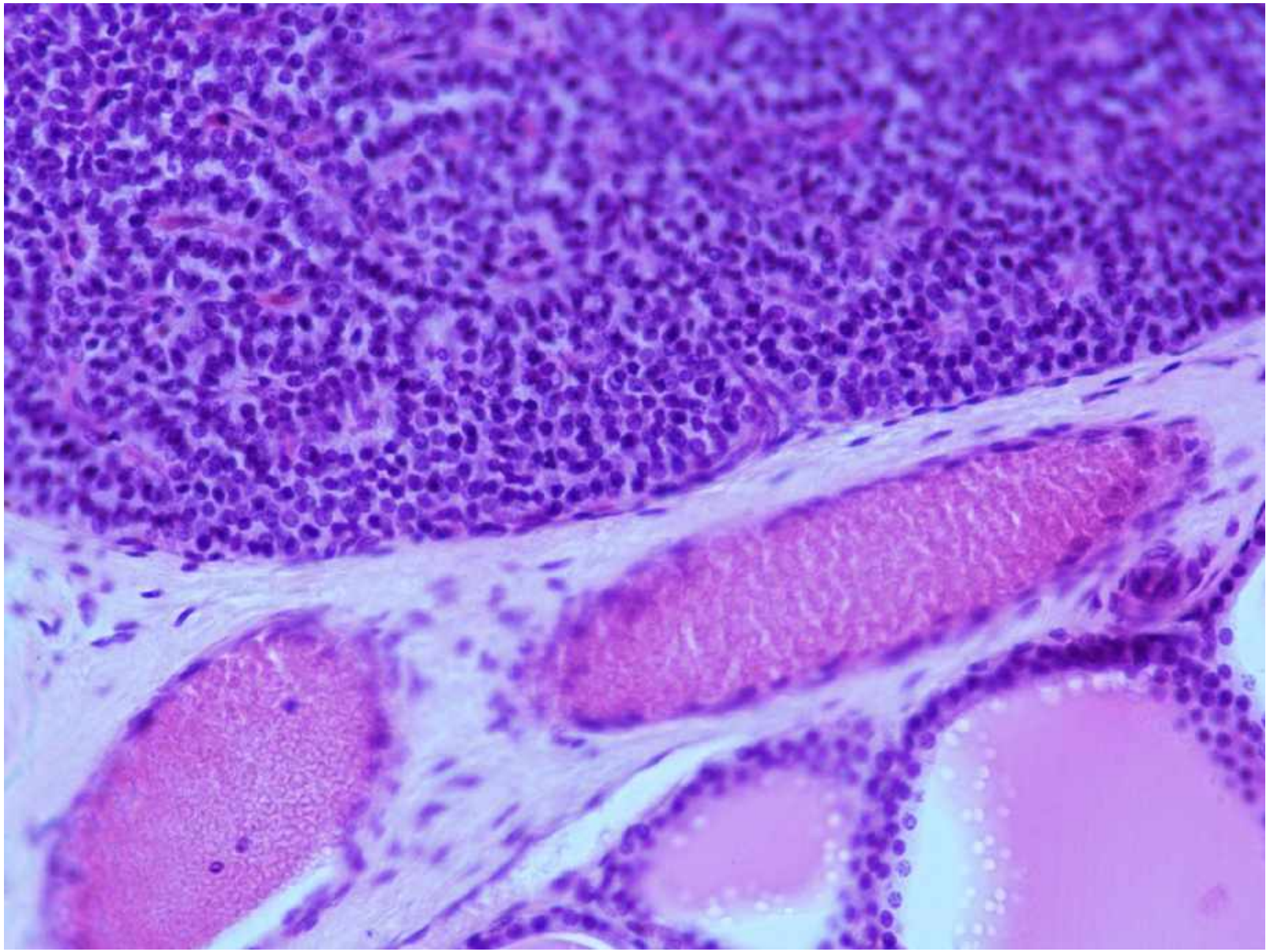
*Slide №111 "*Parathyroid gland (with a fragment of the thyroid), H&E"



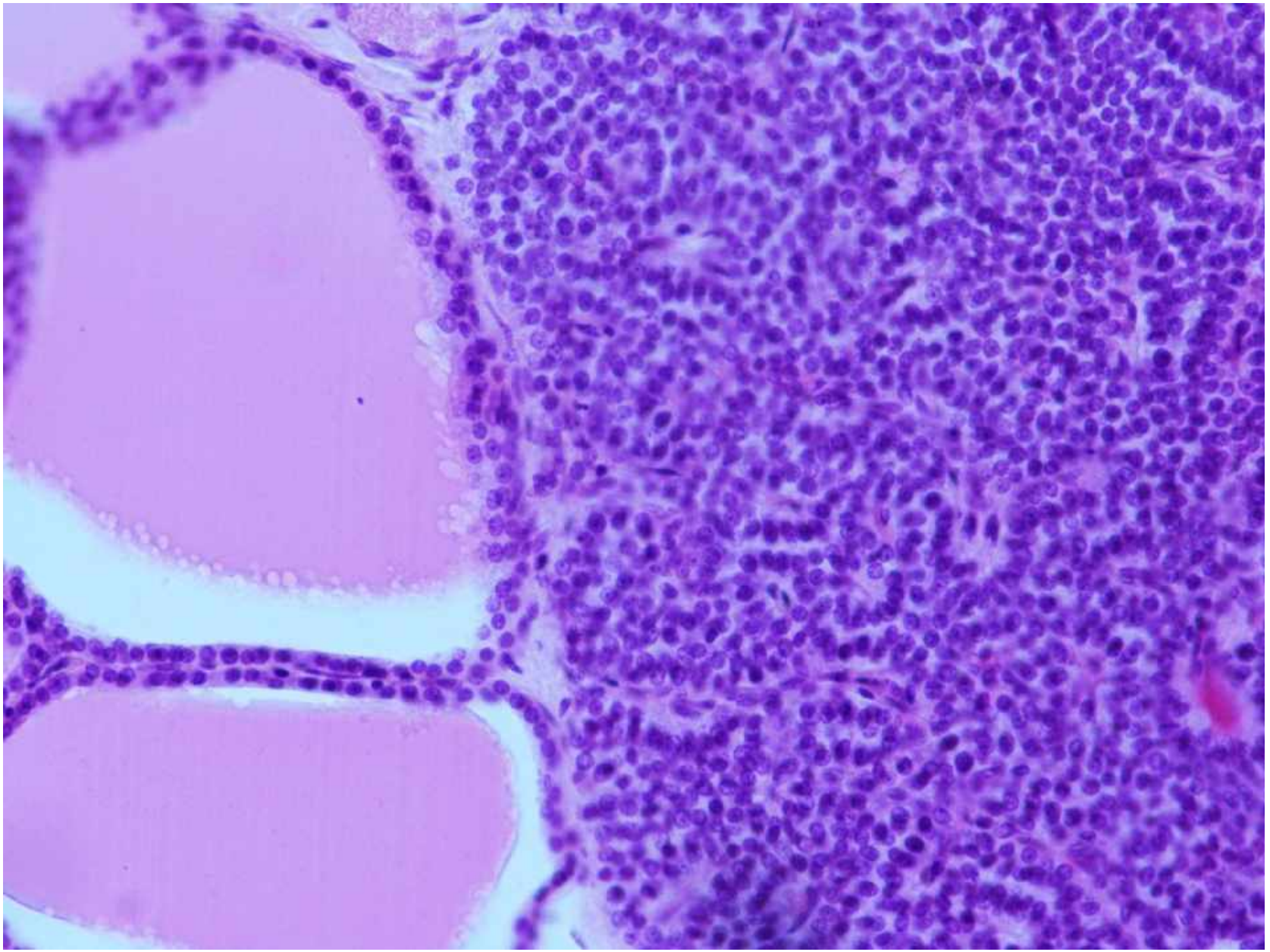
*Slide №111 "*Parathyroid gland (with a fragment of the thyroid), H&E"



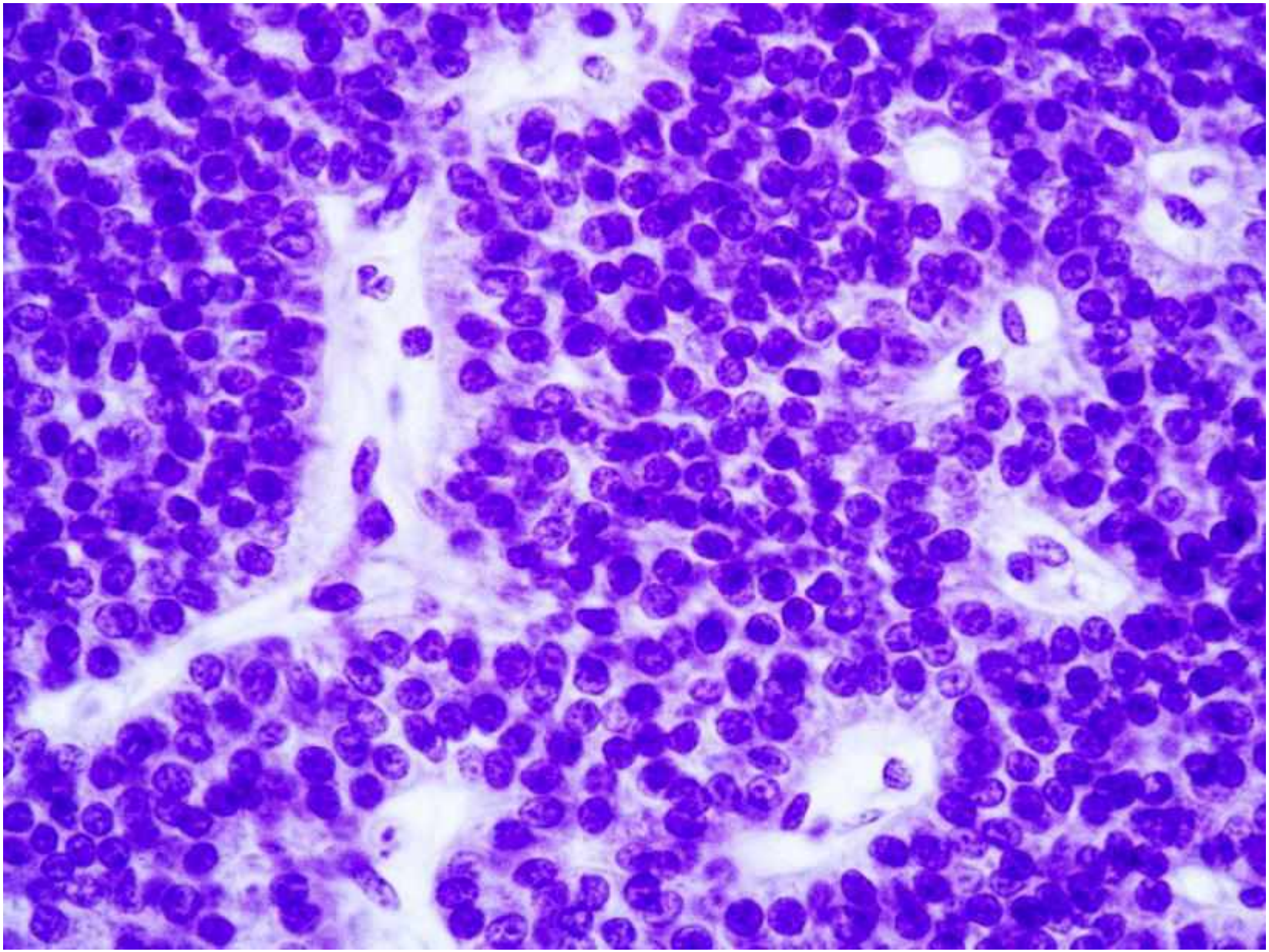
*Slide №111 "*Parathyroid gland (with a fragment of the thyroid), H&E"



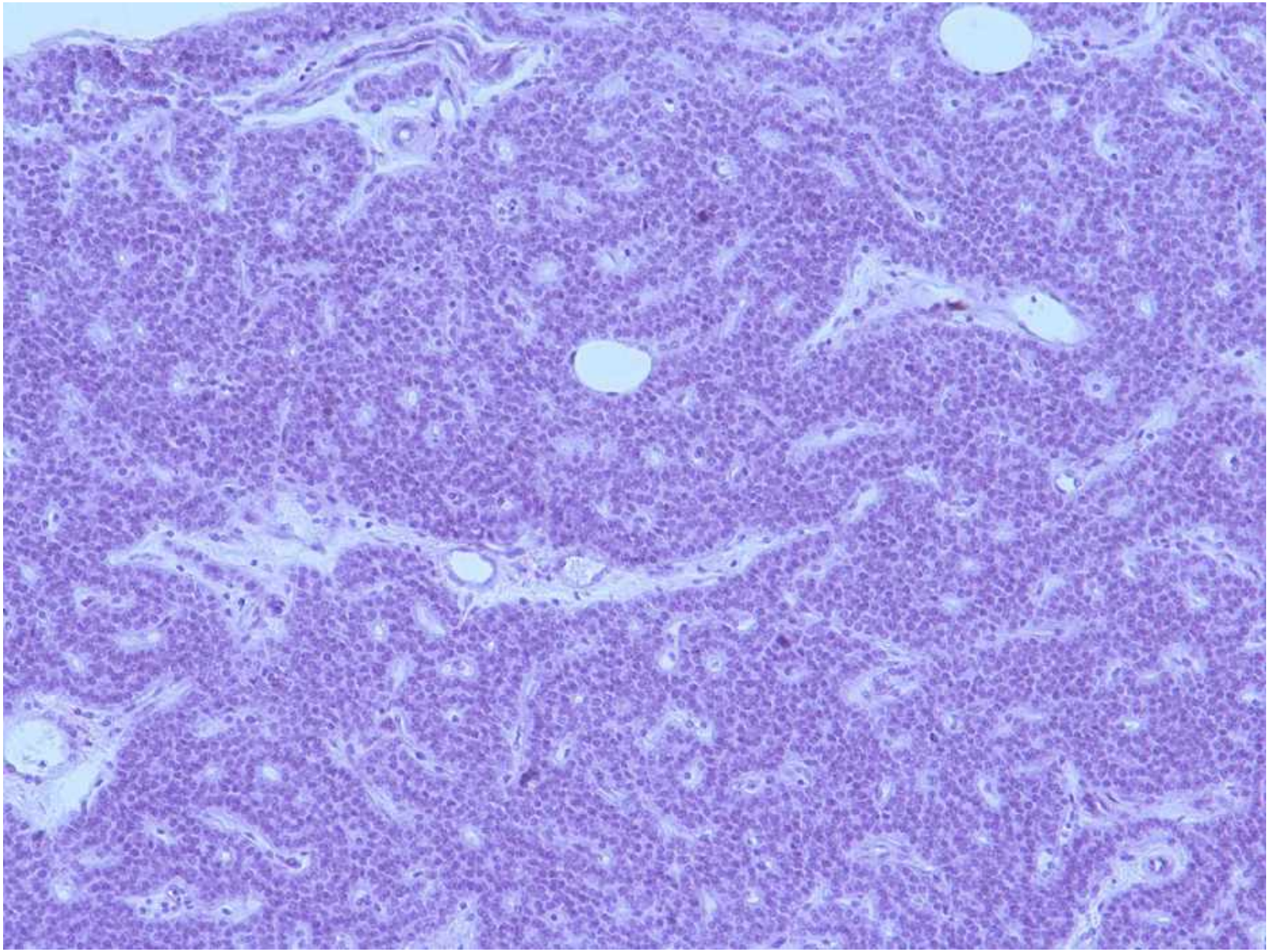
Slide №111 “Parathyroid gland (with a fragment of the thyroid), H&E”



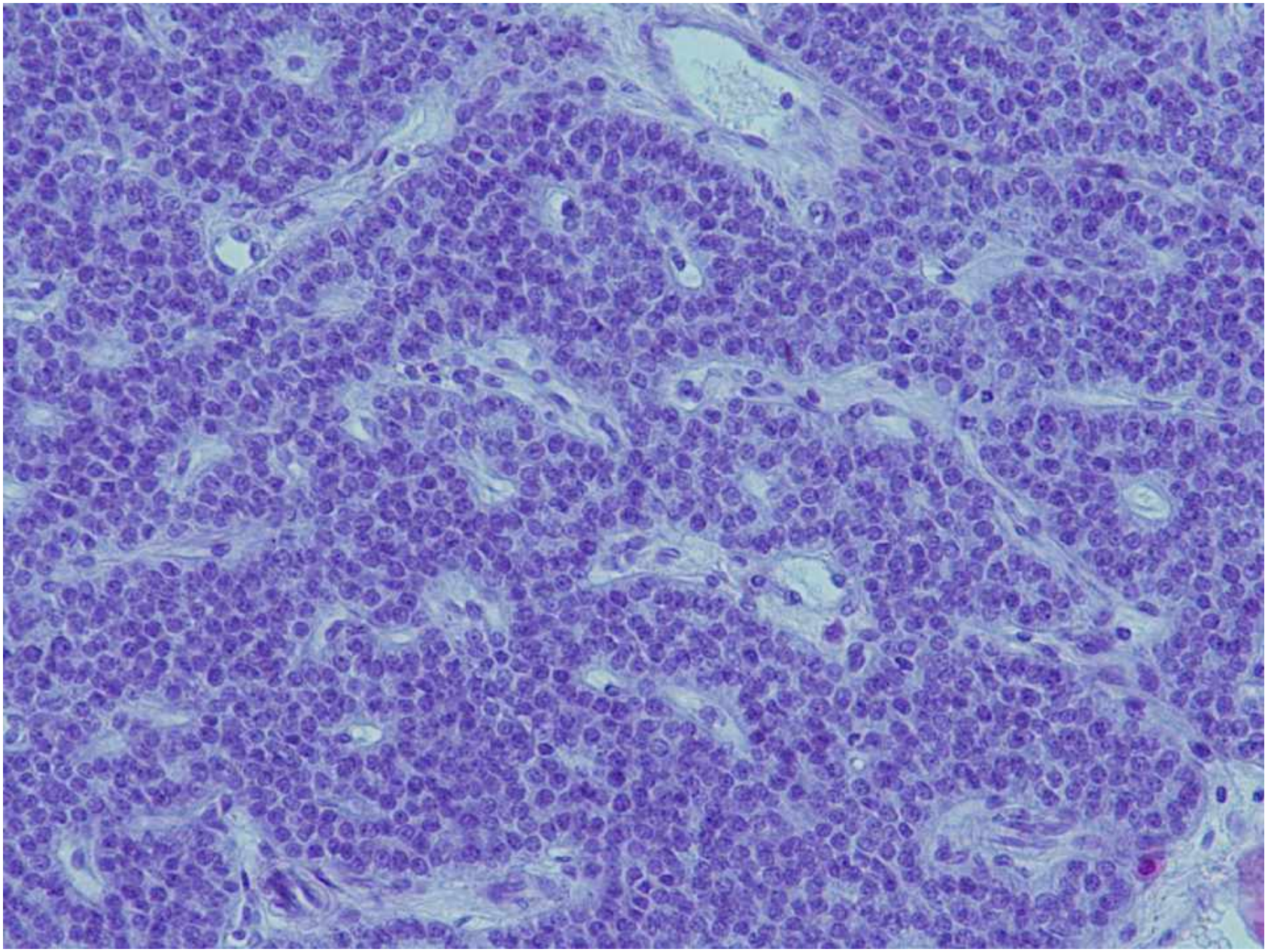
*Slide №111 "*Parathyroid gland (with a fragment of the thyroid), H&E"



*Slide №111 "*Parathyroid gland (with a fragment of the thyroid), H&E"

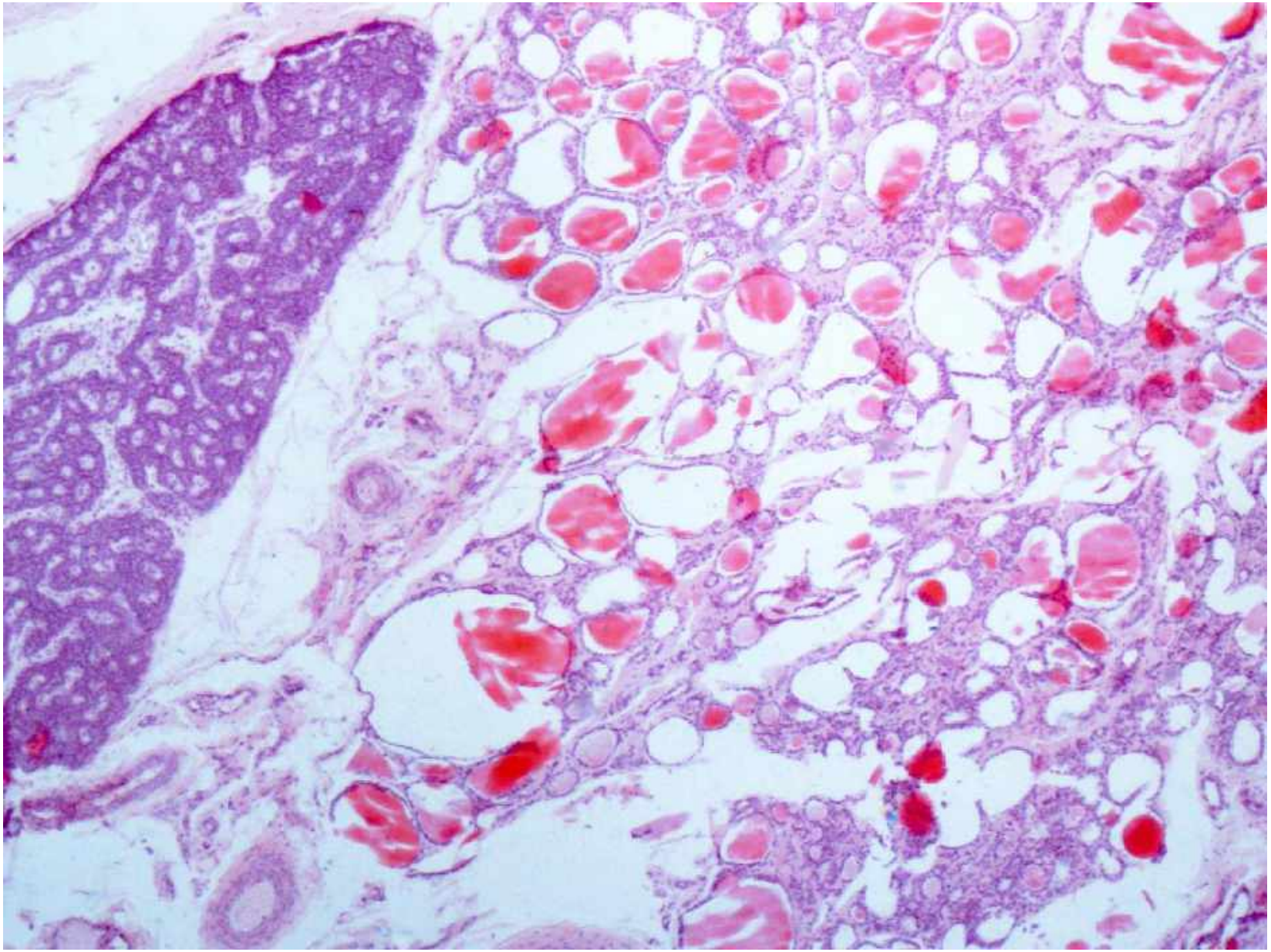


*Slide №111 "*Parathyroid gland (with a fragment of the thyroid), H&E"

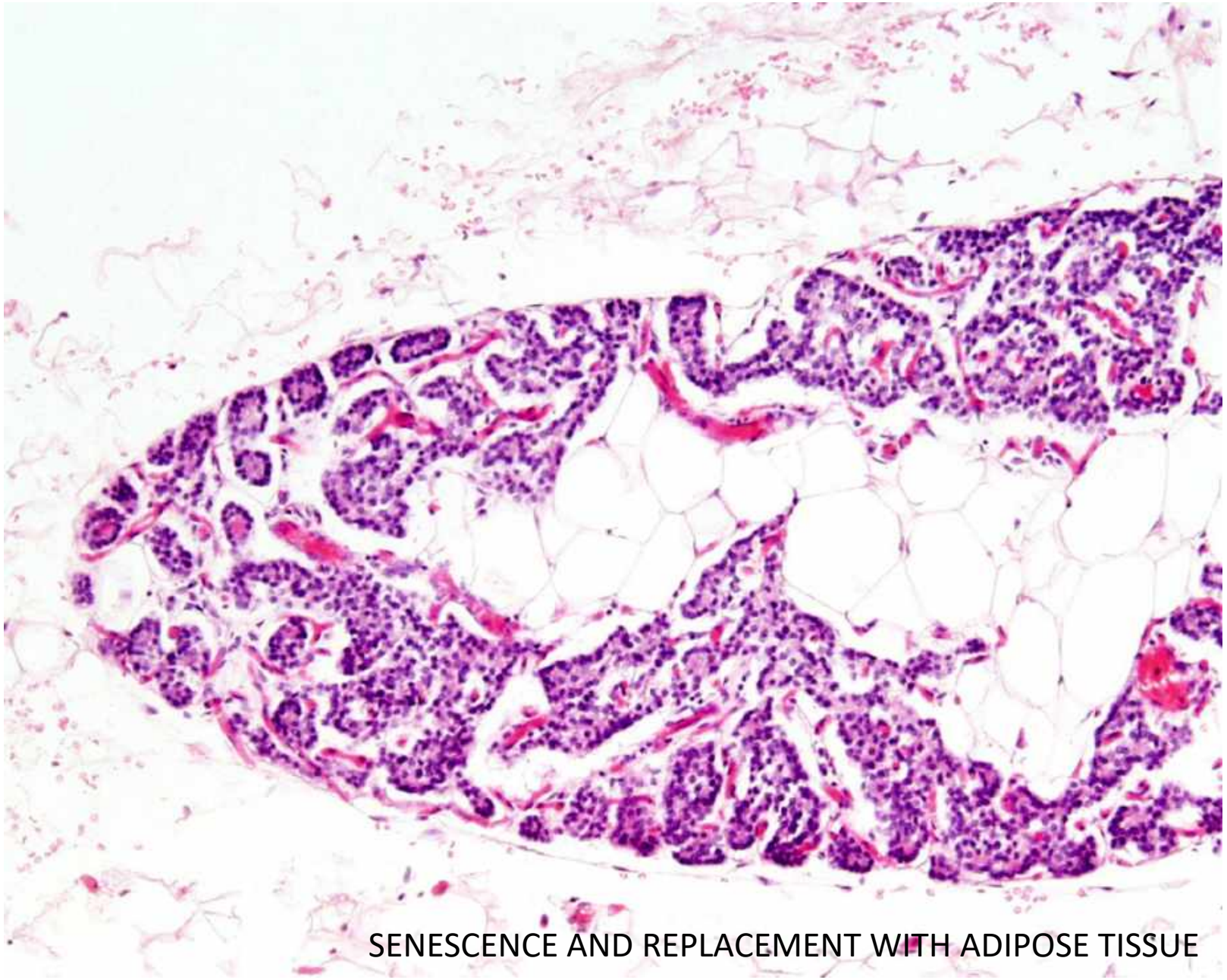


Slide №111 “Parathyroid gland (with a fragment of the thyroid), H&E”

*Slide №111 "*Parathyroid gland (with a fragment of the thyroid), H&E"



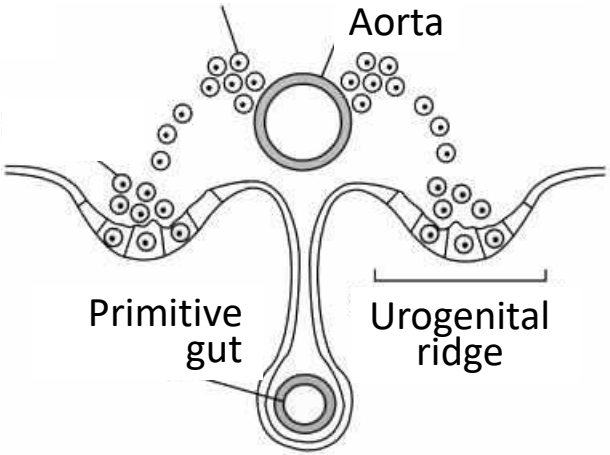
*Slide №111 "*Parathyroid gland (with a fragment of the thyroid), H&E"

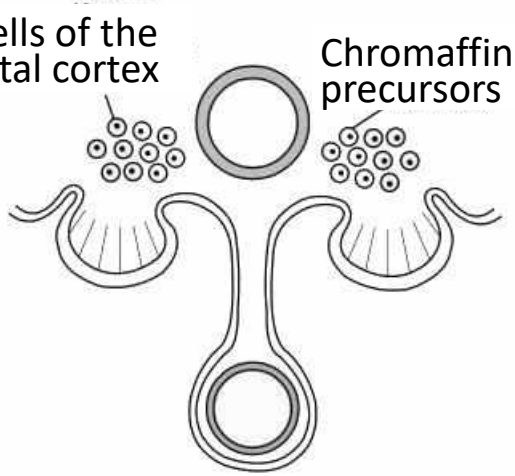


SENESCENCE AND REPLACEMENT WITH ADIPOSE TISSUE

ADRENAL GLANDS *DEVELOPMENT*

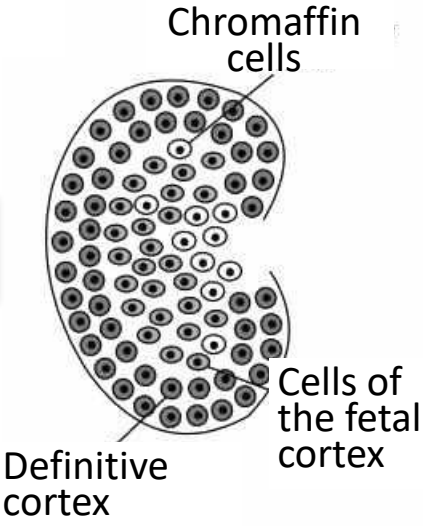
5 weeks

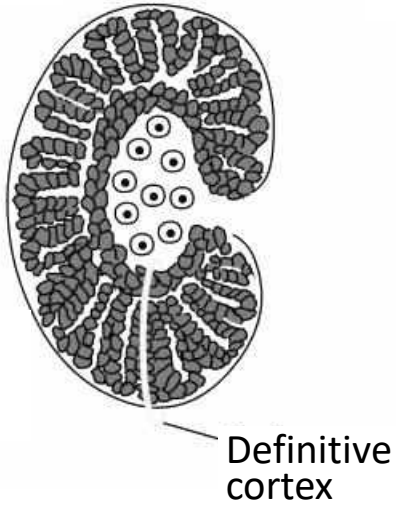


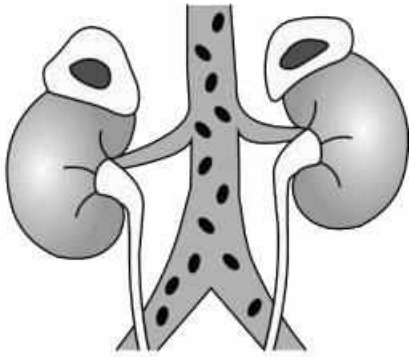


6-7 weeks

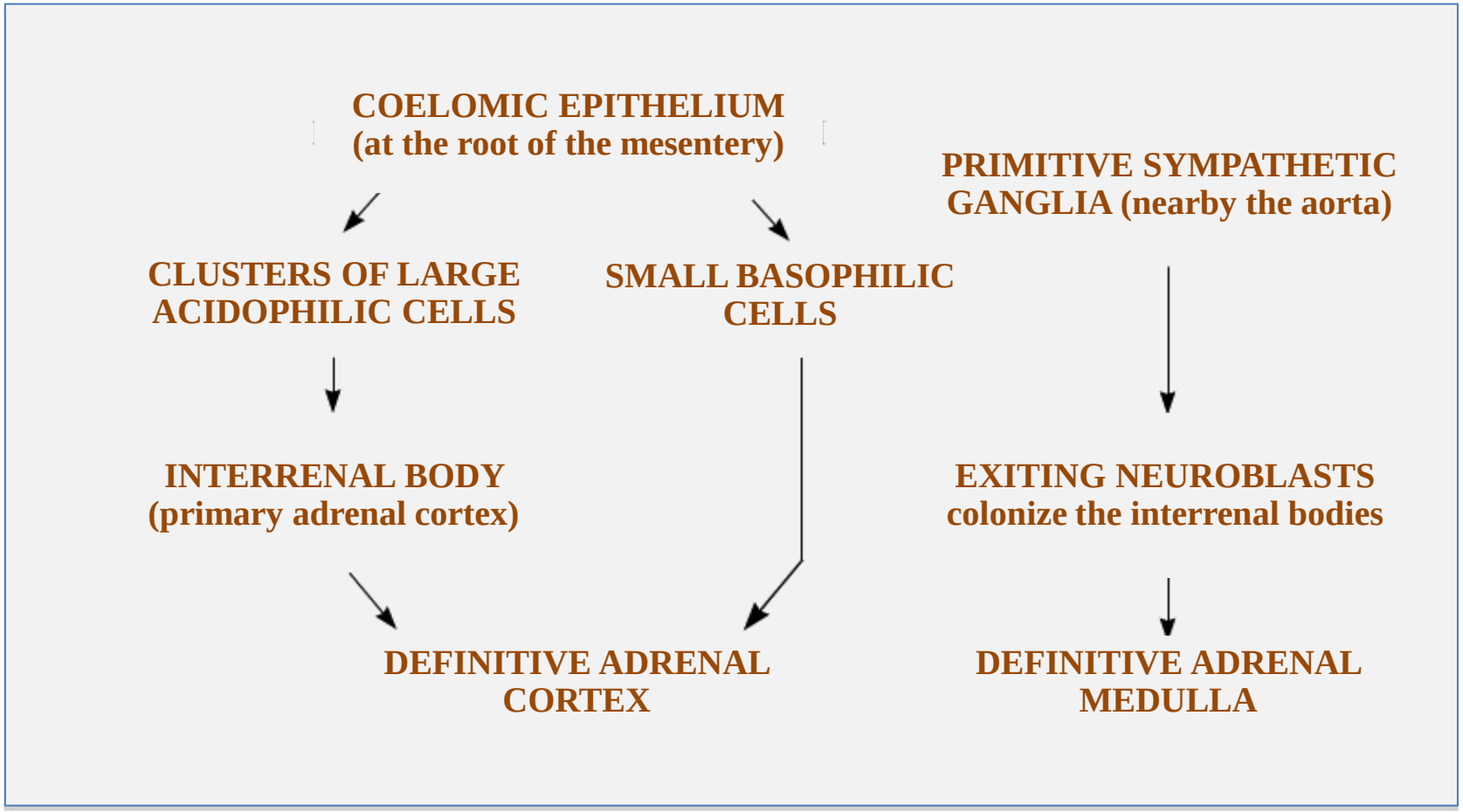
10 weeks



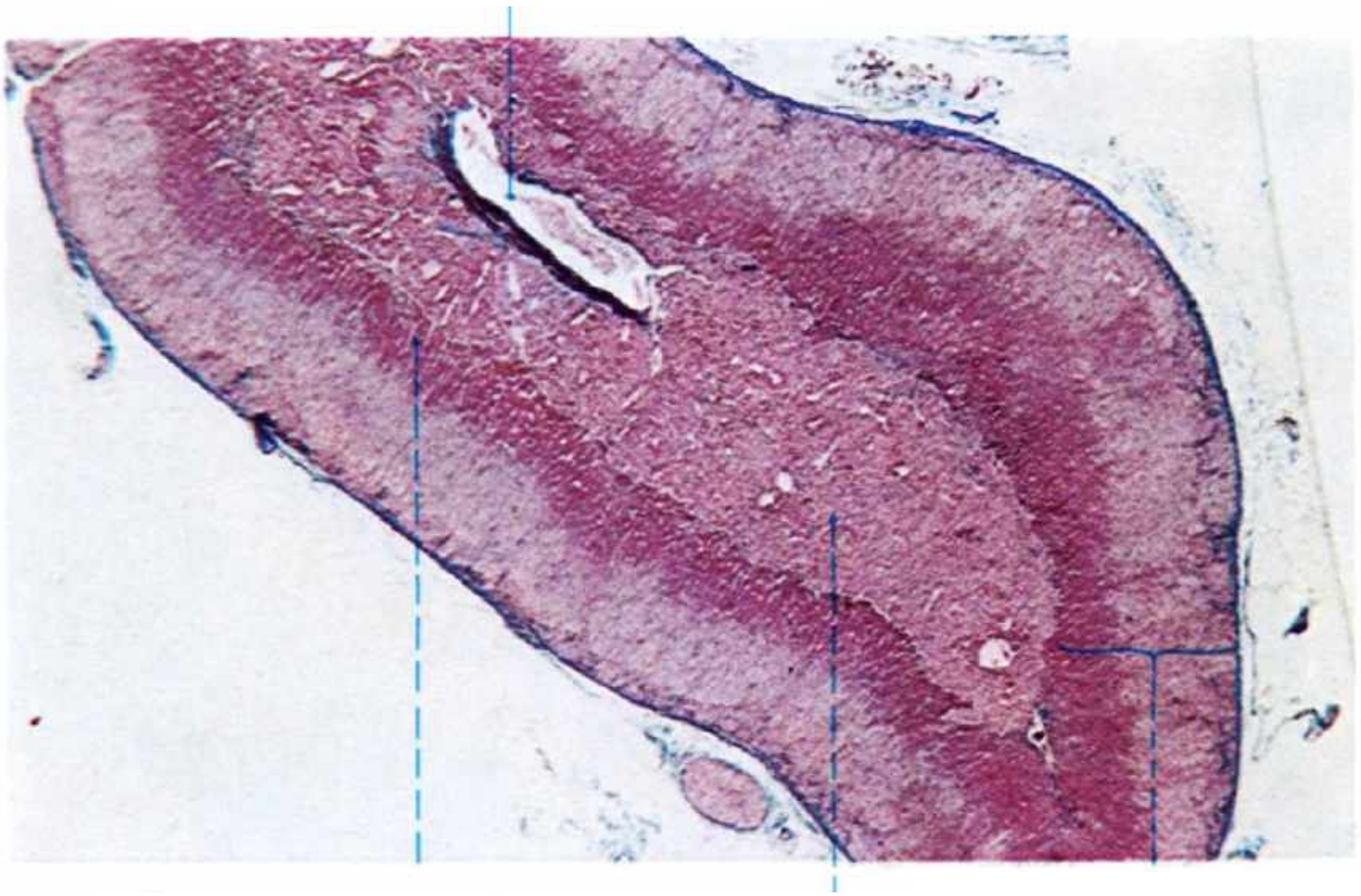




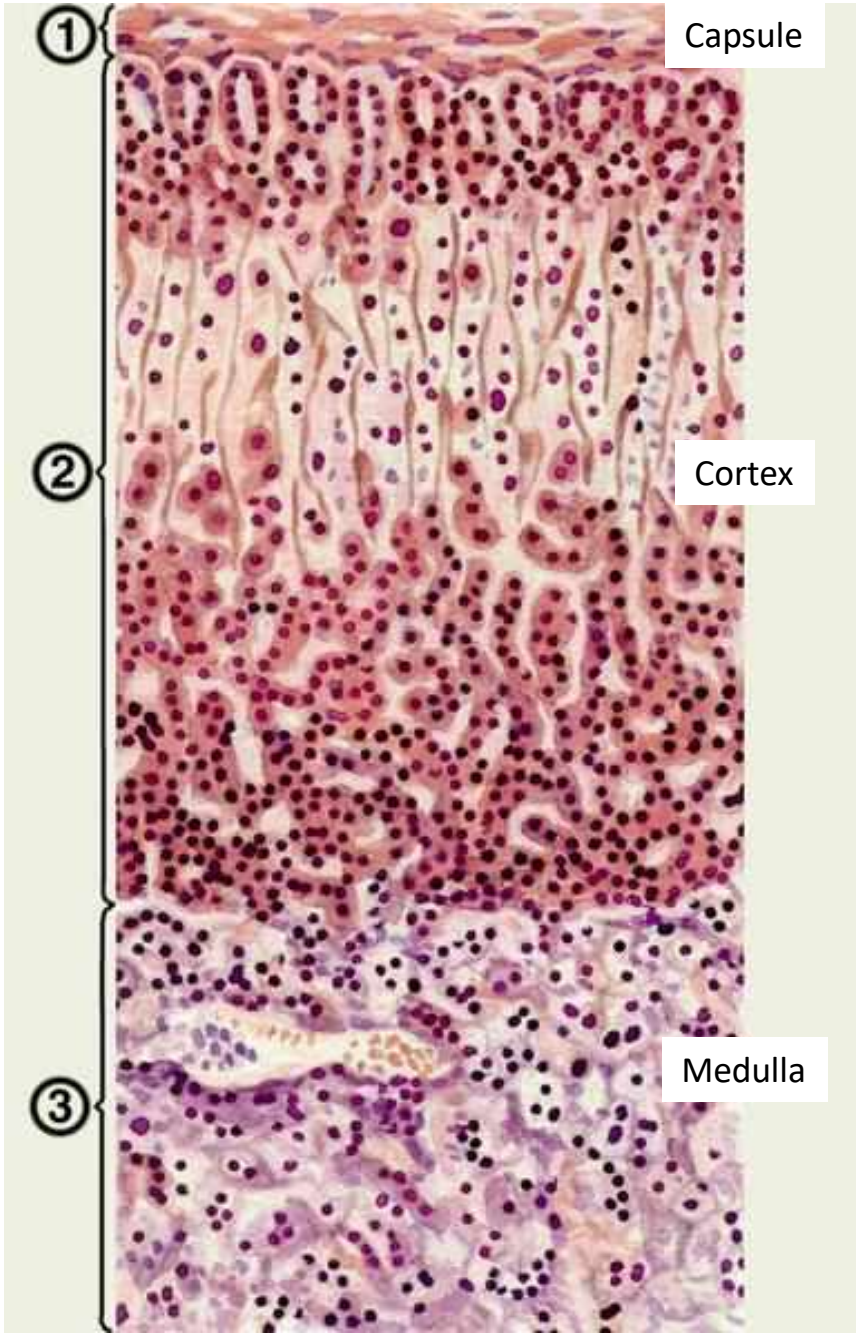
ADRENAL GLANDS DEVELOPMENT

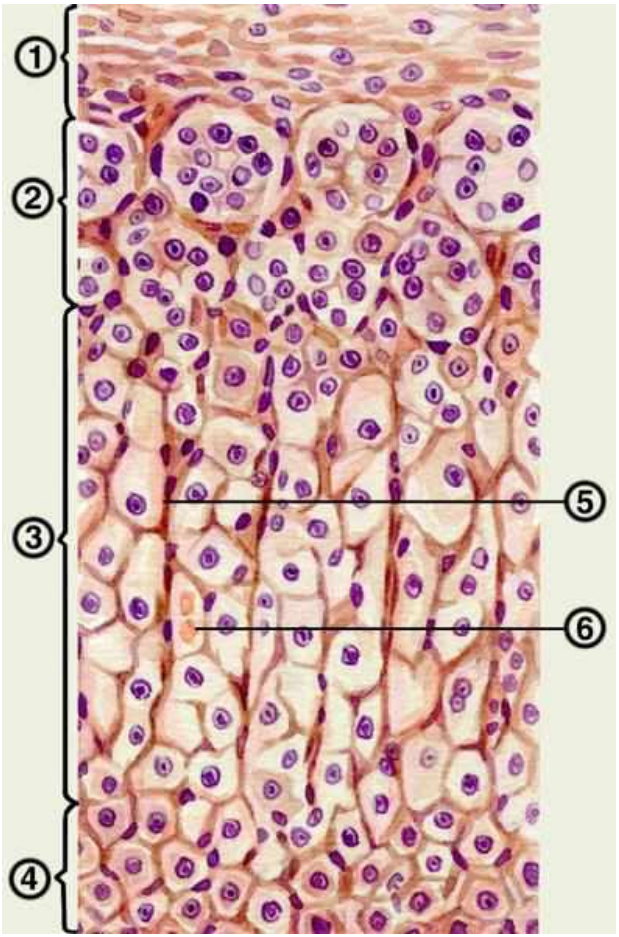


ADRENAL GLAND



HISTOLOGIC STRUCTURE OF THE ADRENAL CORTEX





1 — connective tissue capsule;
2 — zona glomerulosa;
3 — zona fasciculata;
4 — zona reticularis;
5 — streaks of connective tissue;
6 — blood vessel

ADRENAL CORTEX

Factors that regulate hormone production

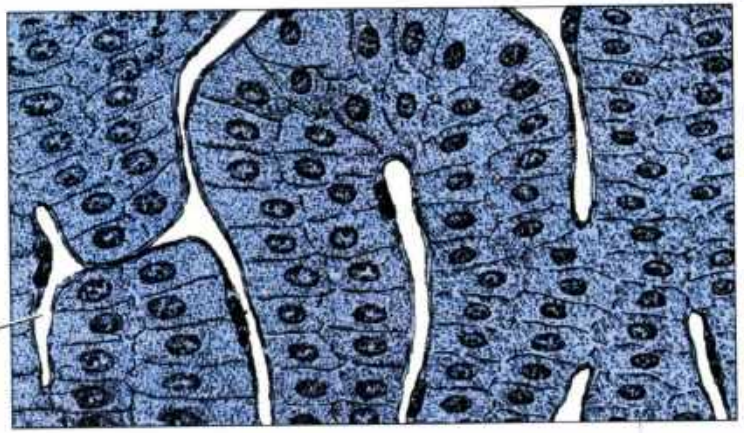
Secreted hormones

Angiotensin and ACTH

Mineralocorticoids (aldosterone)

Capillaries

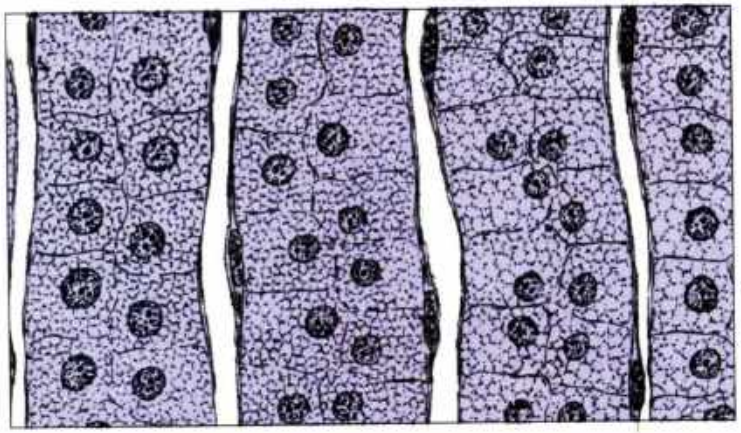
Zona glomerulosa



Zona fasciculata

ACTH

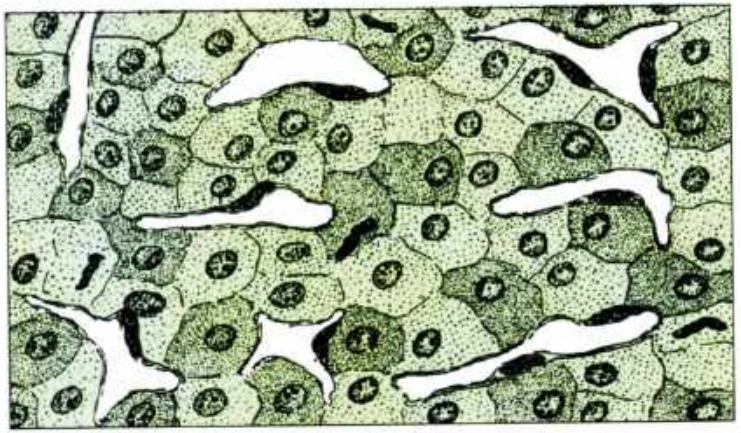
Glucocorticoids (cortisol, corticosterone)



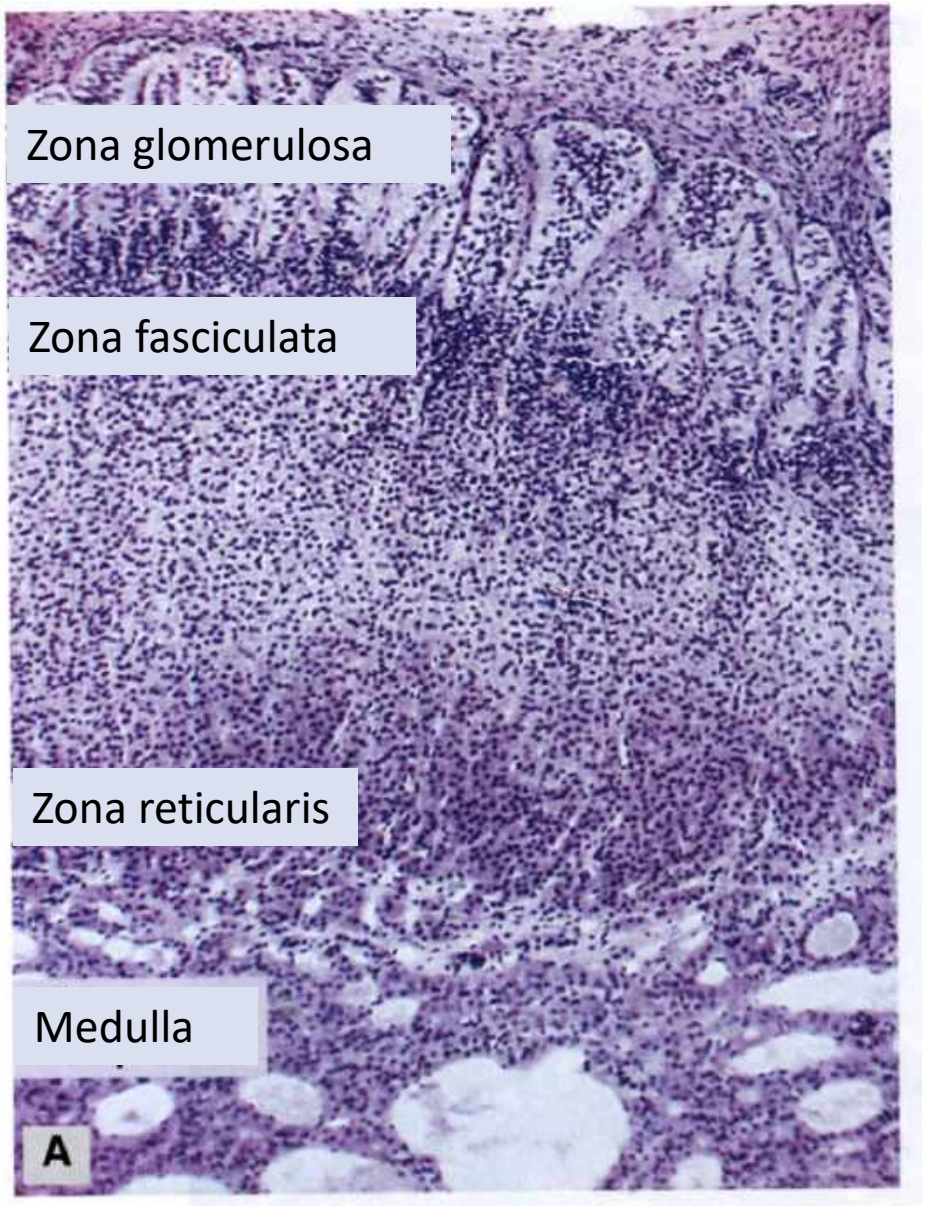
Zona reticularis

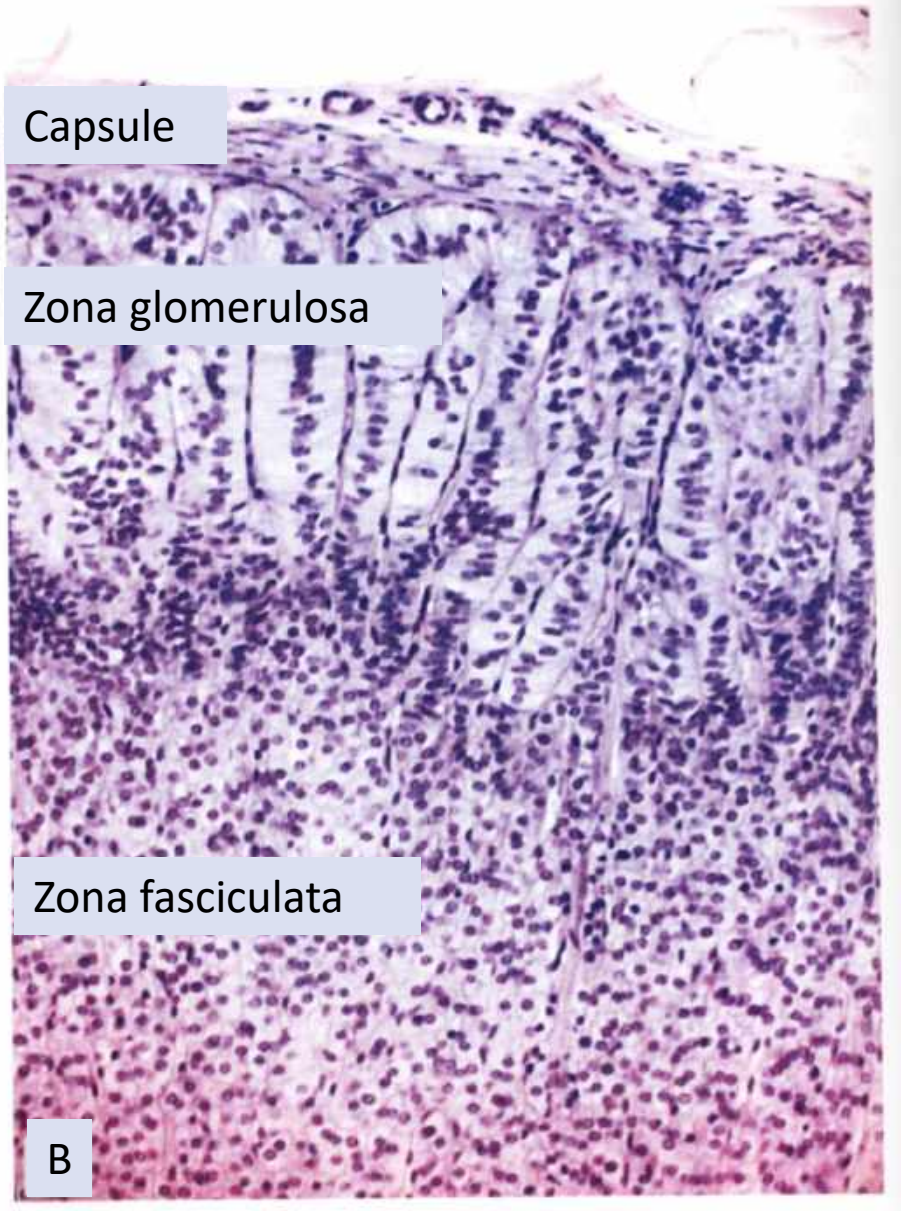
ACTH

Androgens

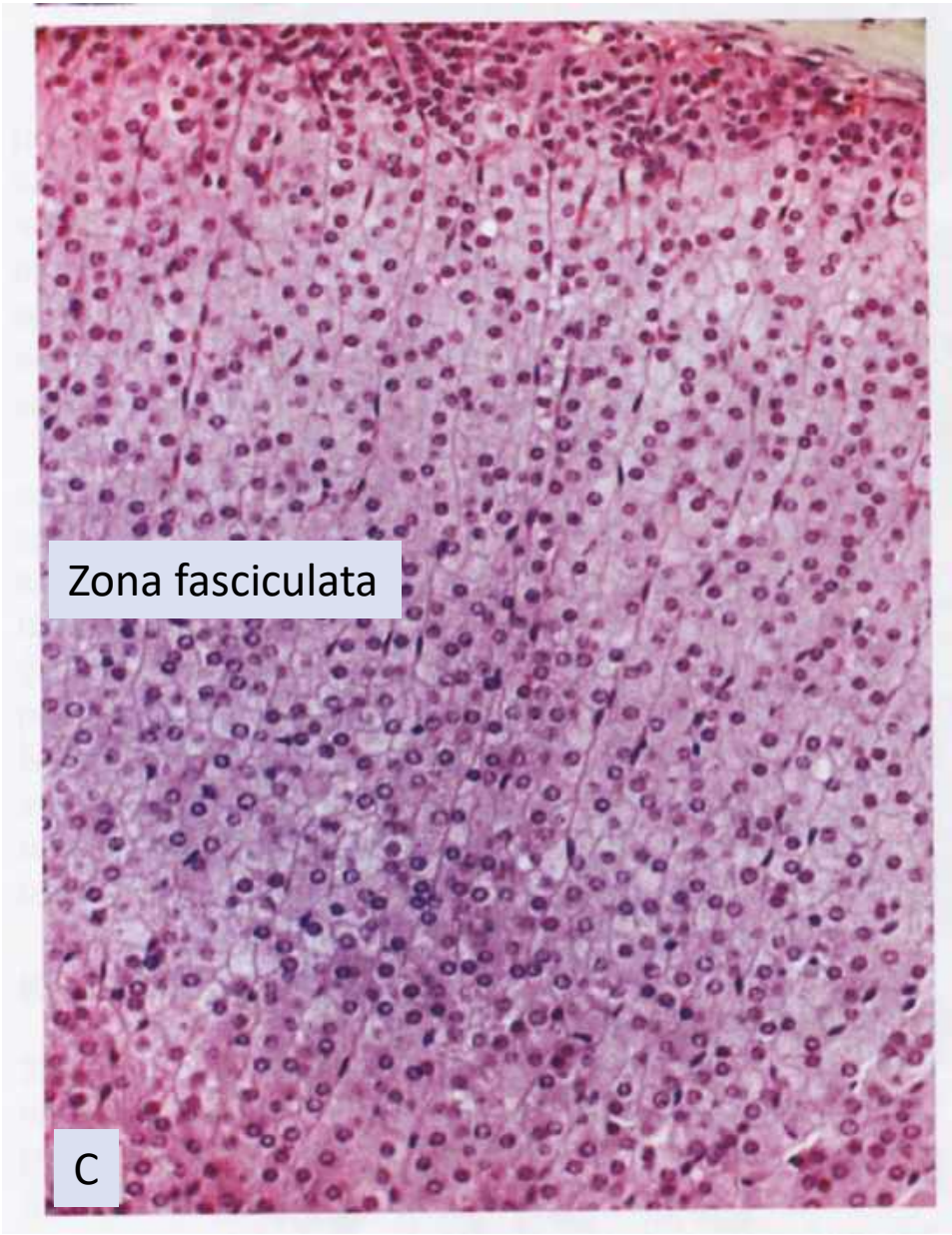


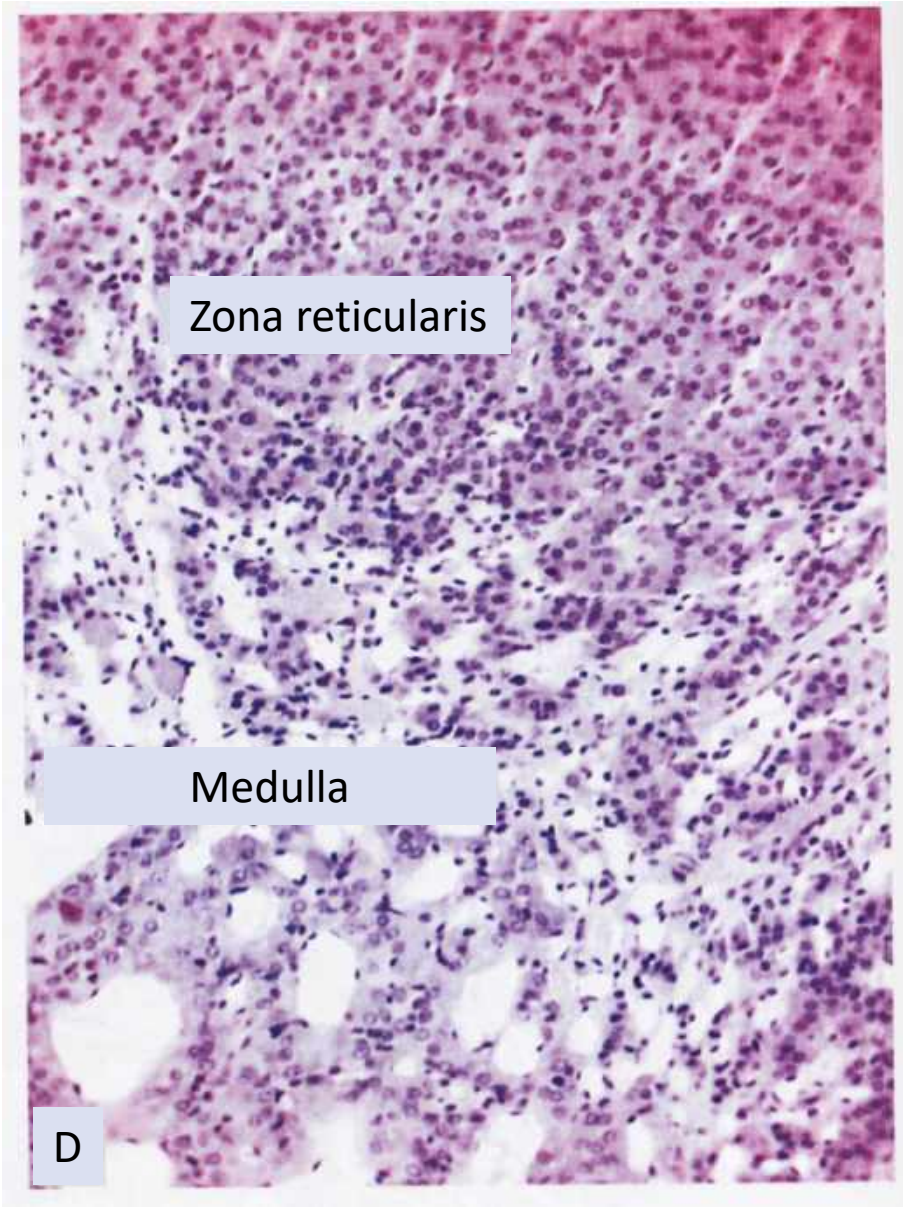
ADRENAL CORTEX



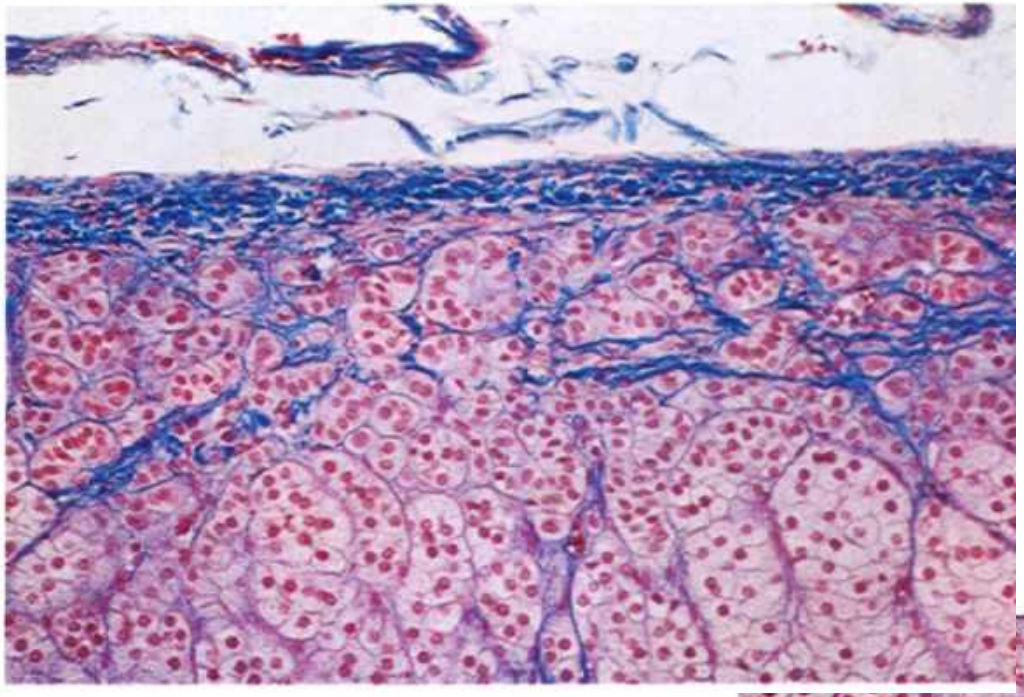


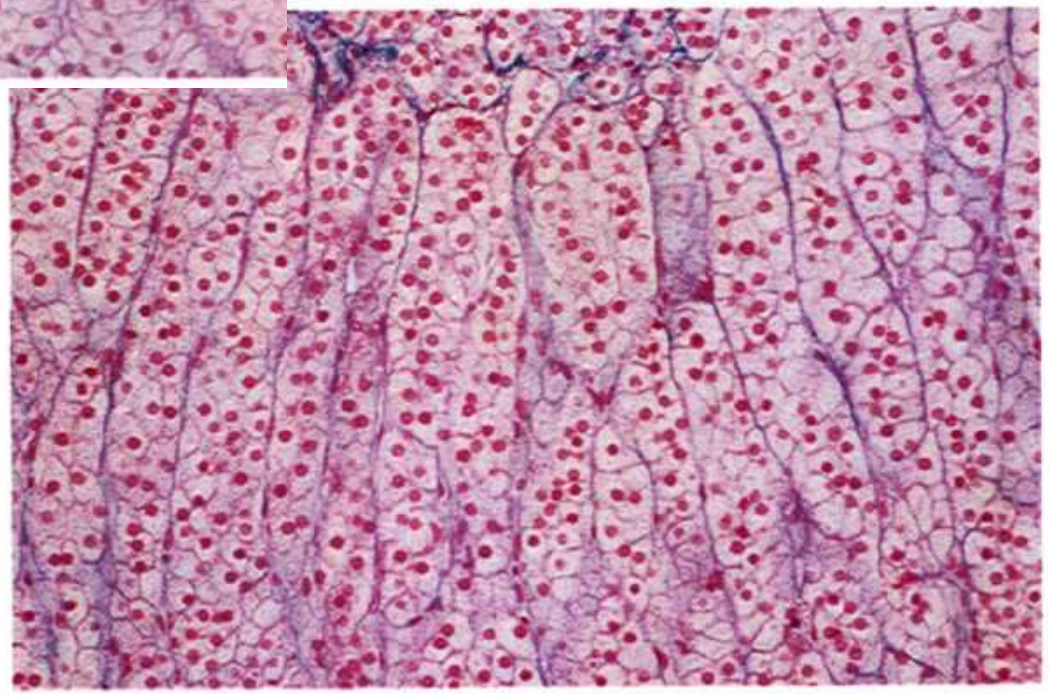
ADRENAL CORTEX



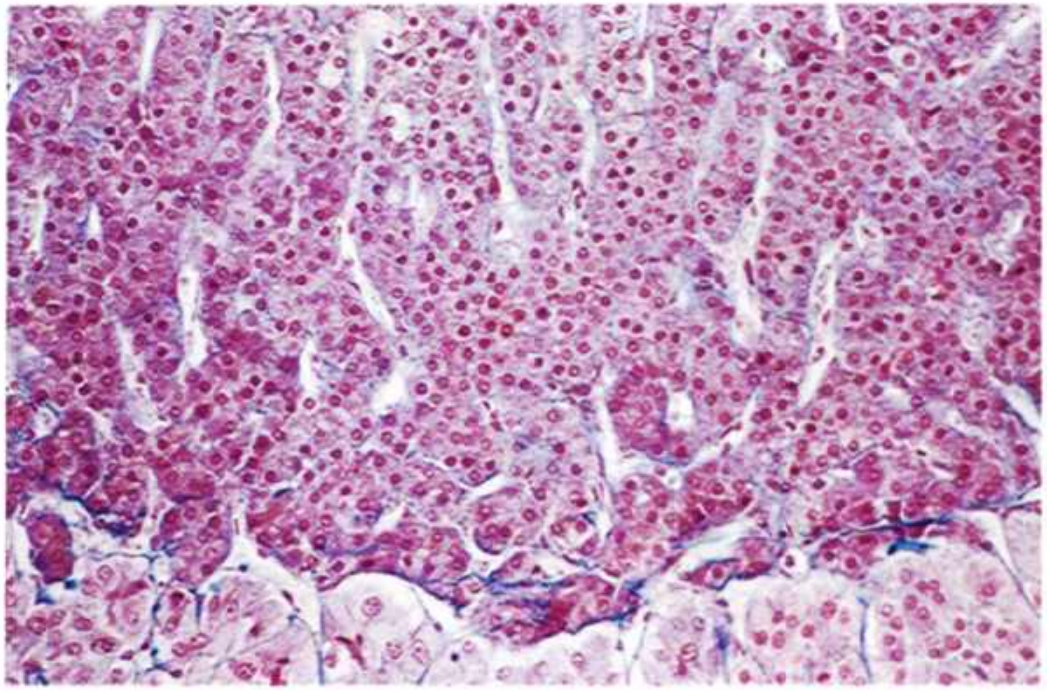


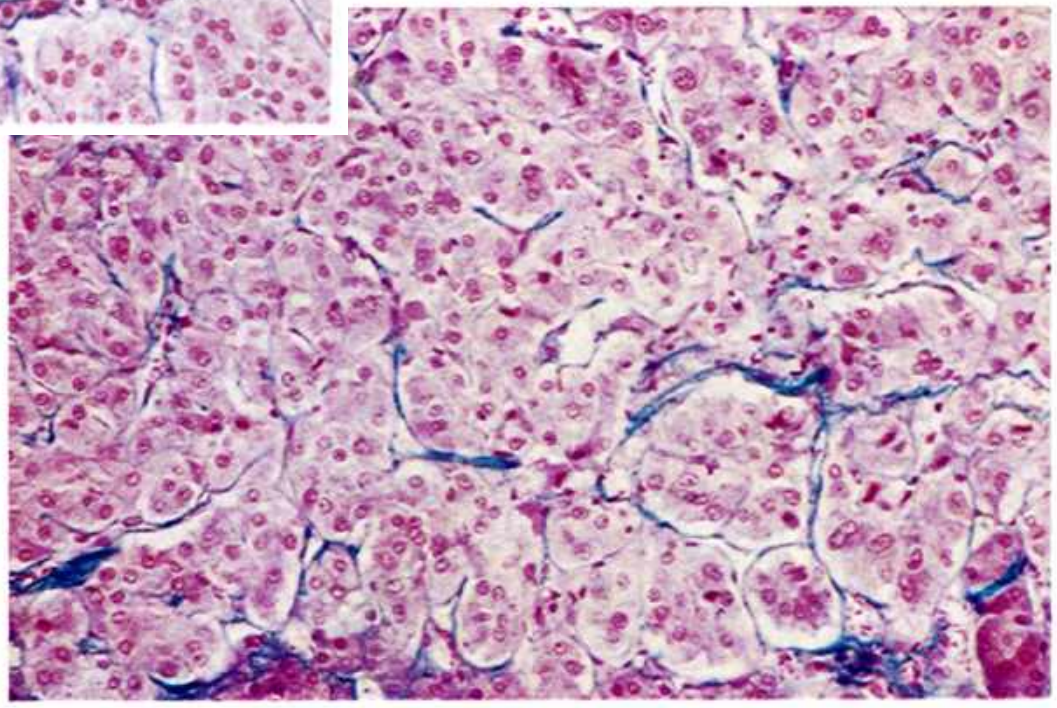
ADRENAL CORTEX





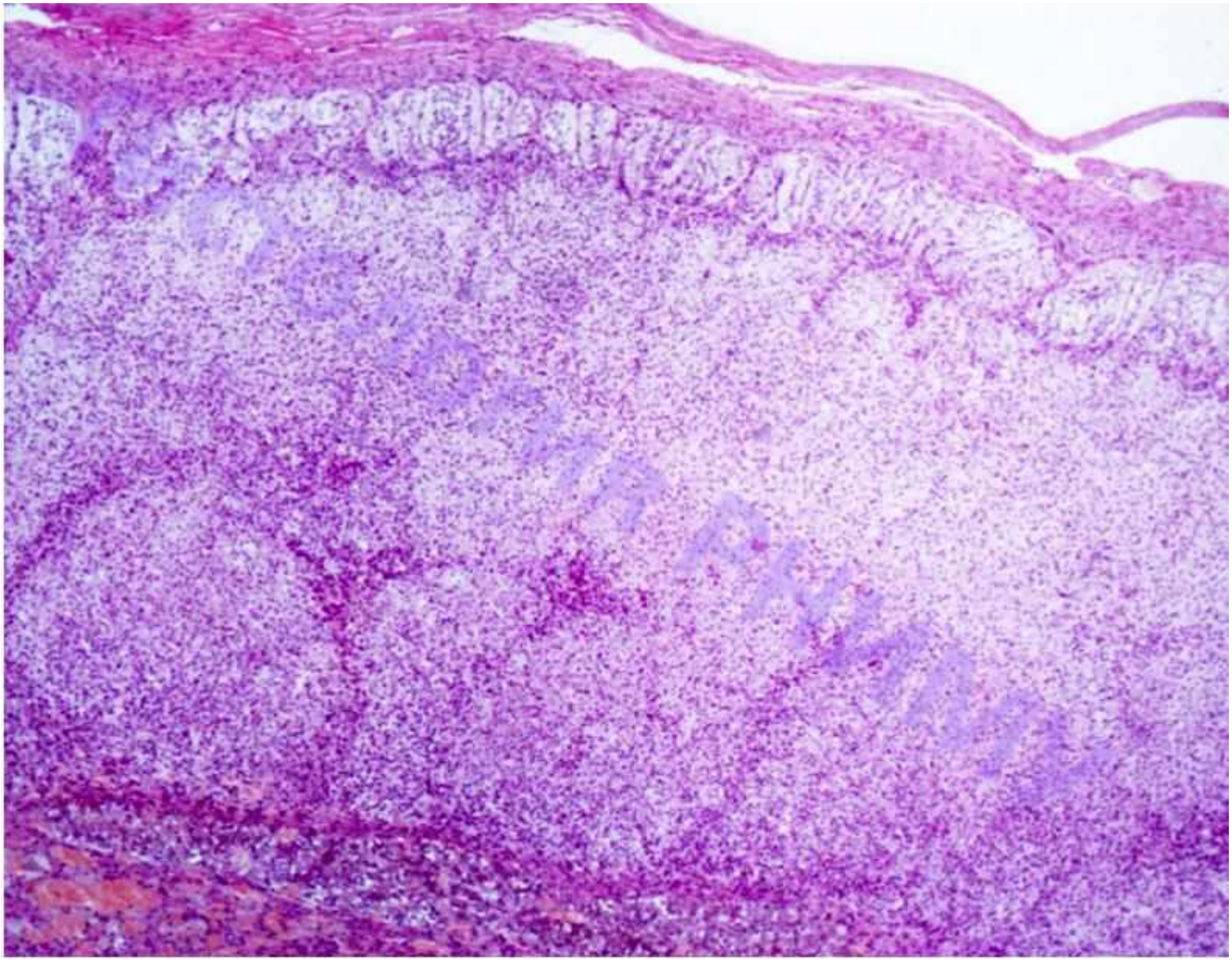
ADRENAL CORTEX



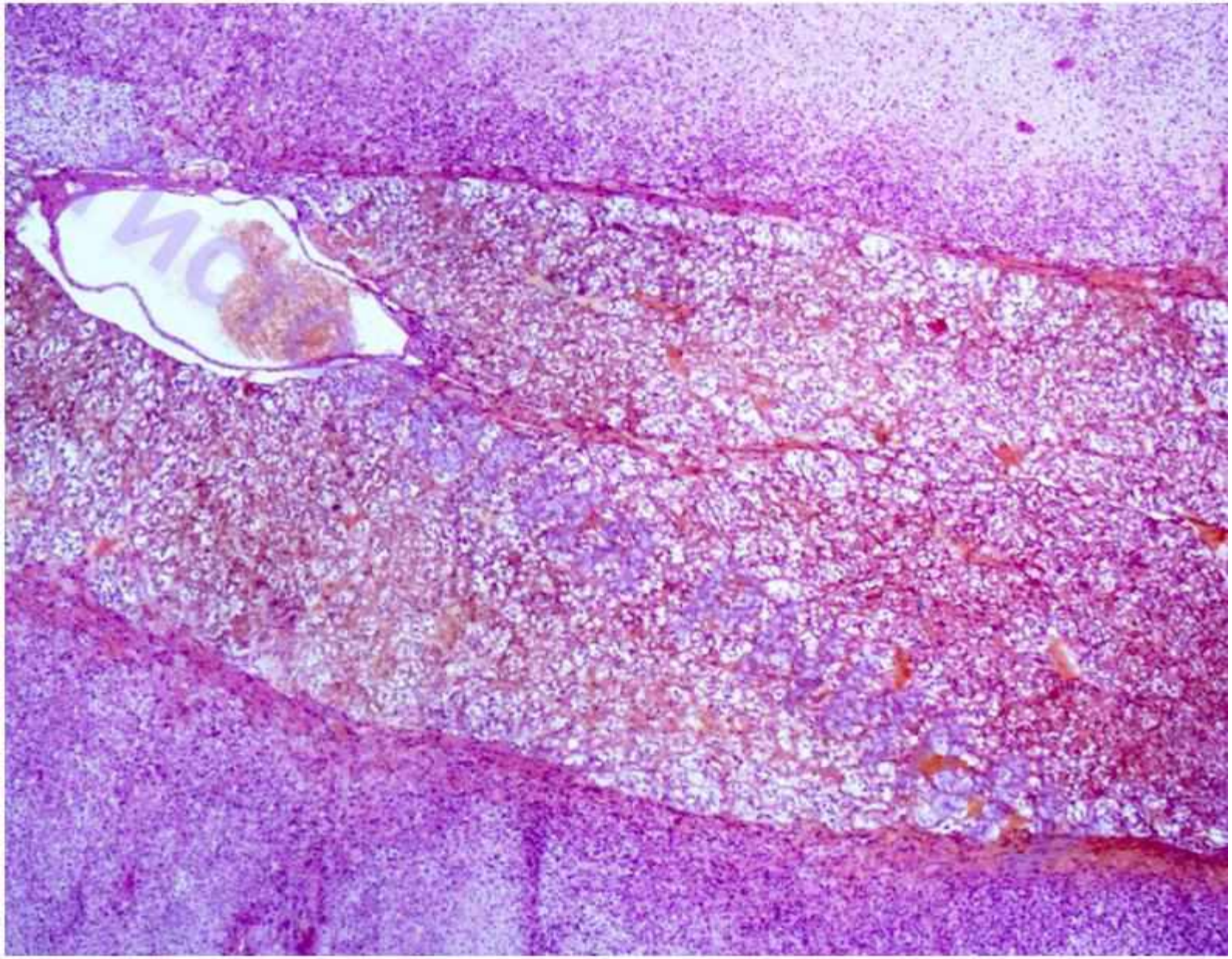


Slide №112 “Adrenal gland, H&E”

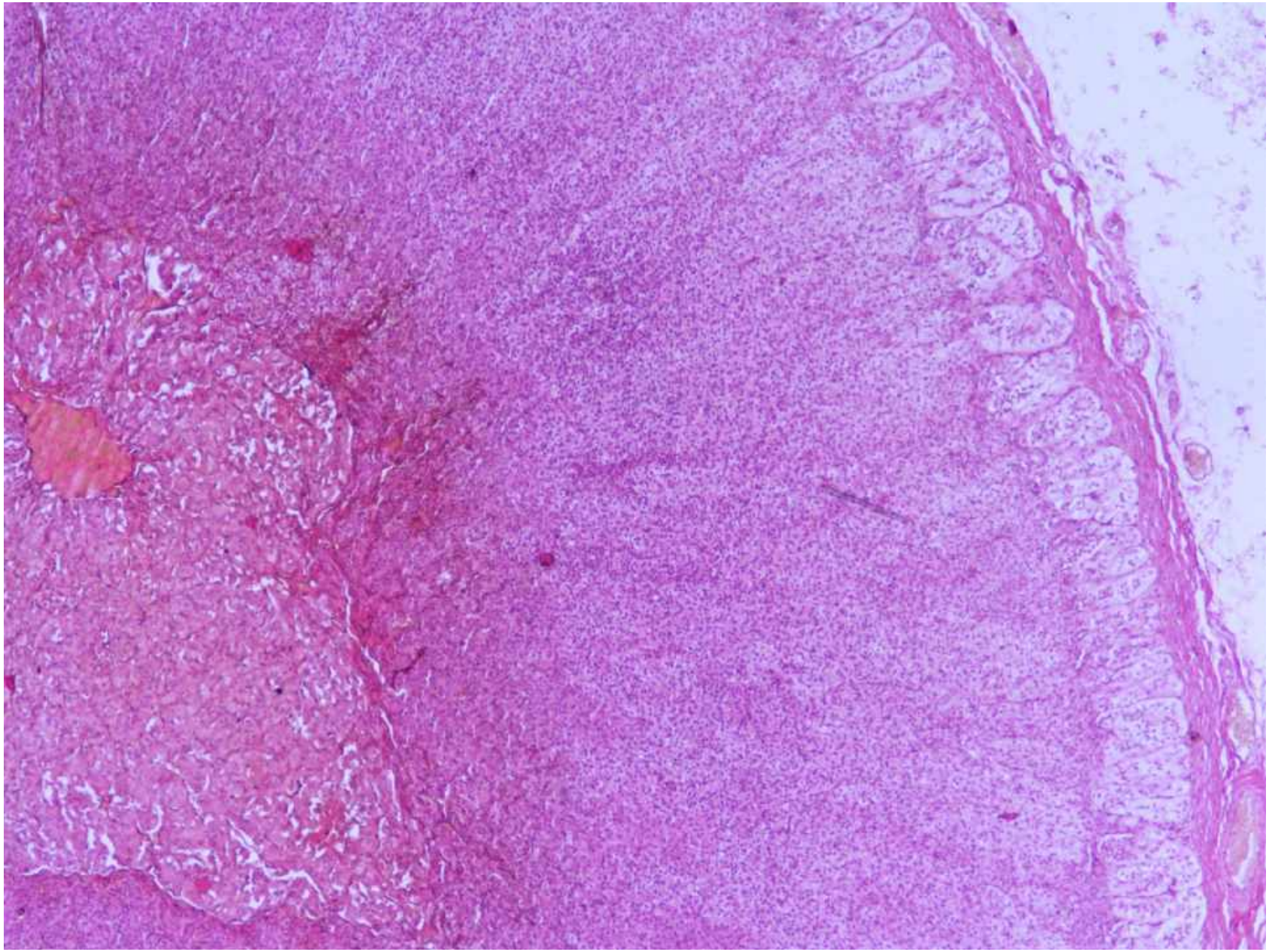
Slide №112 “Adrenal gland, H&E”



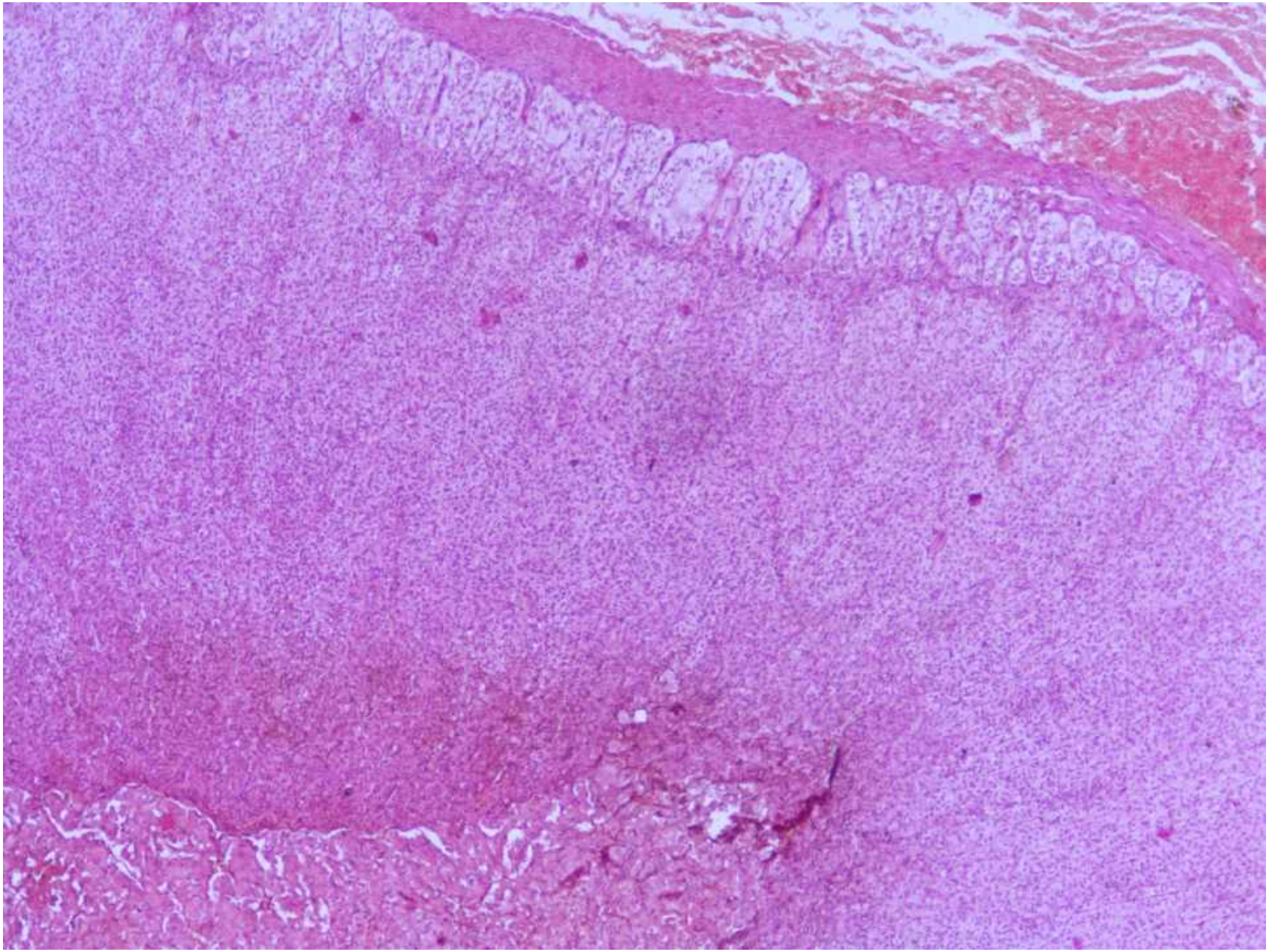
*Slide №112 "*Adrenal gland, H&E"



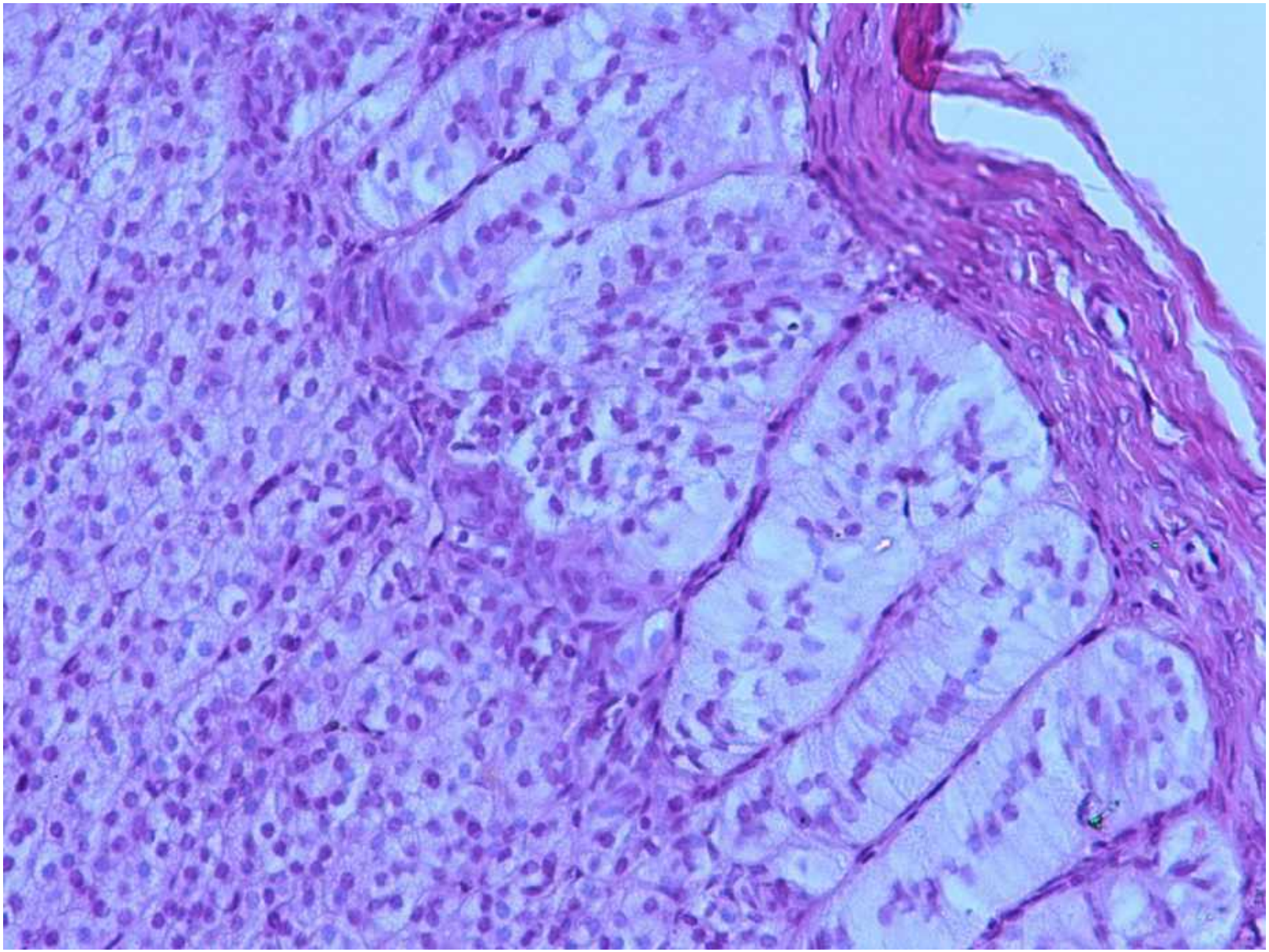
*Slide №112 "*Adrenal gland, H&E"



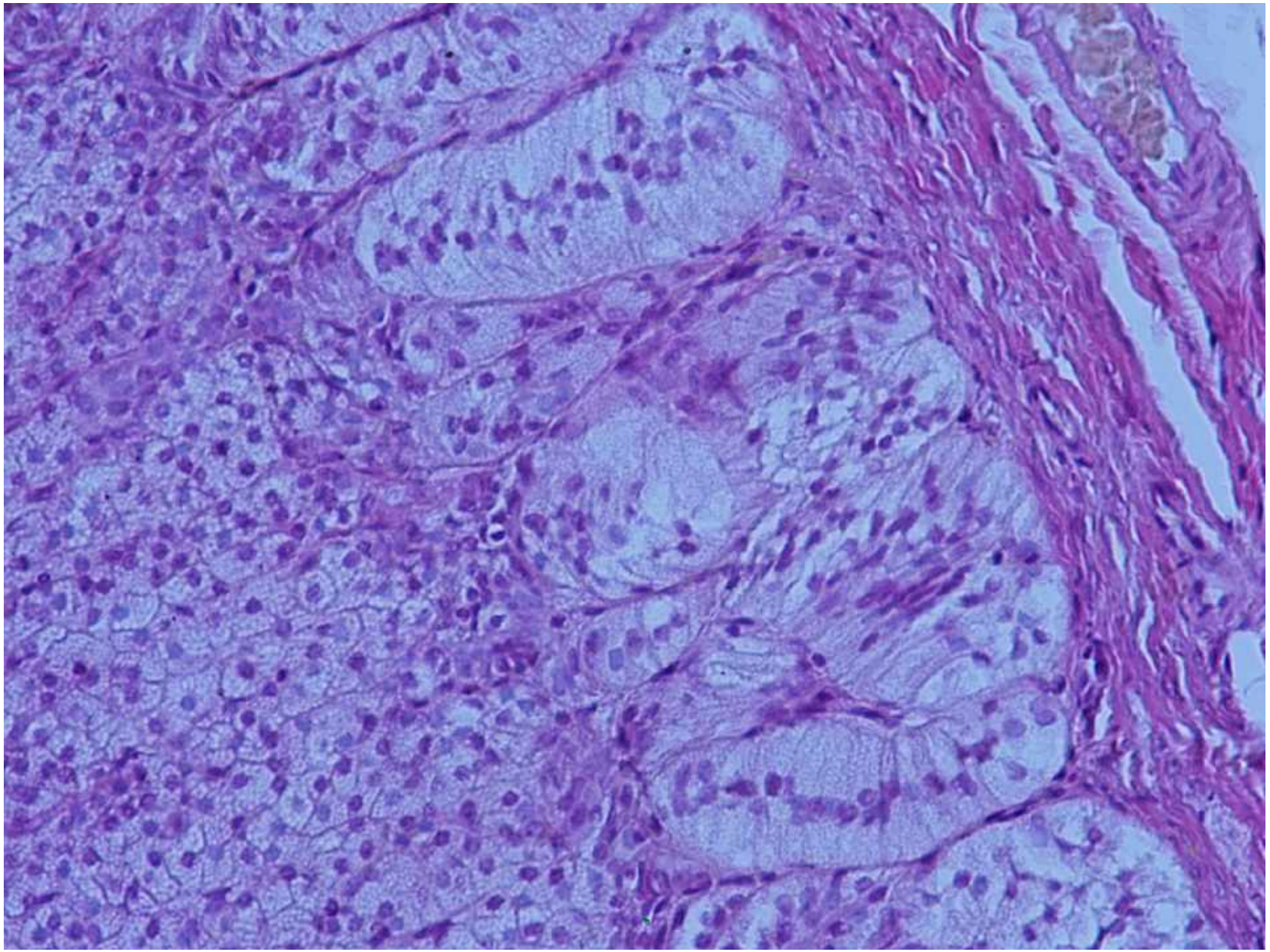
*Slide №112 "*Adrenal gland, H&E"



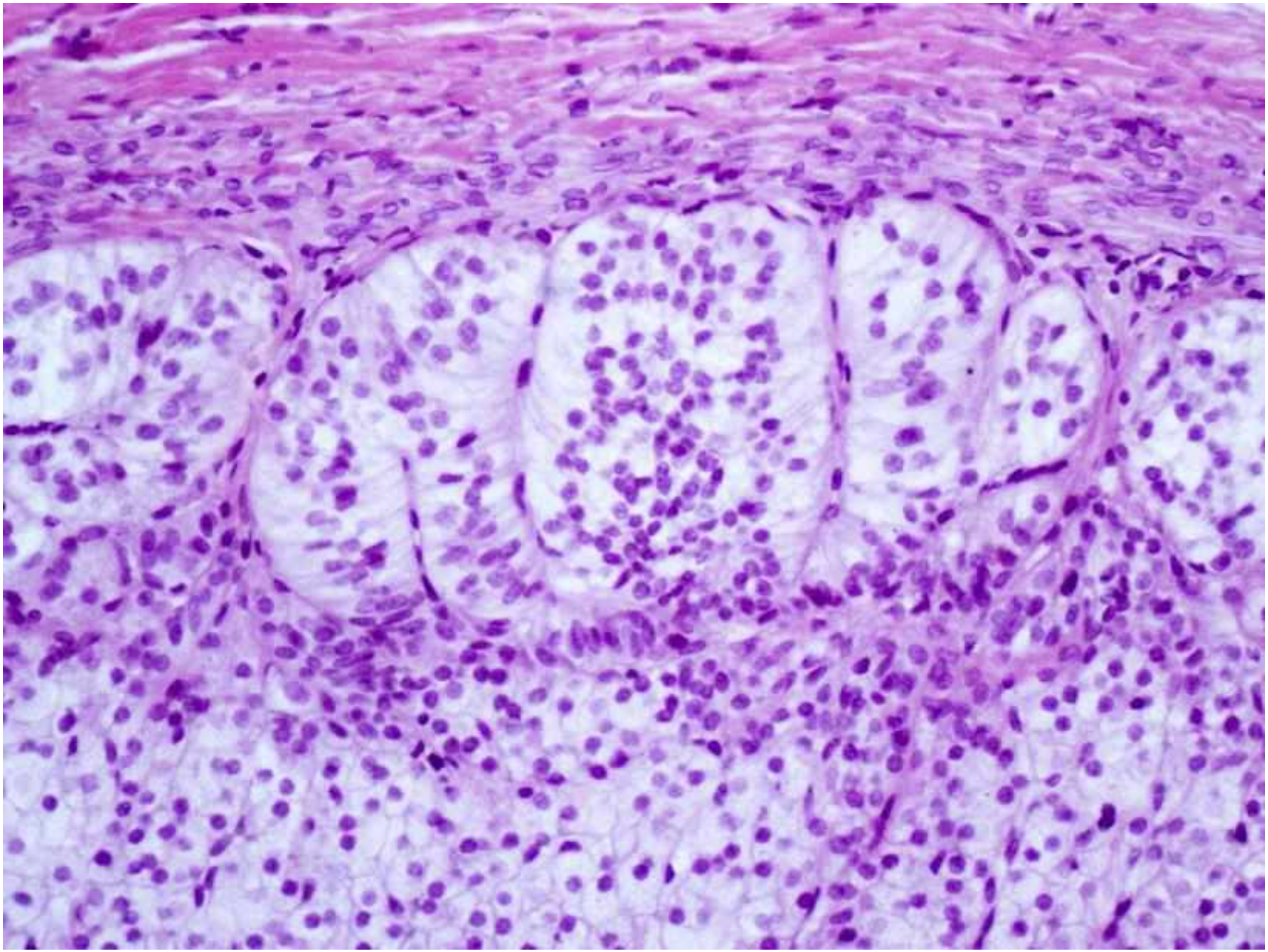
*Slide №112 "*Adrenal gland, H&E"



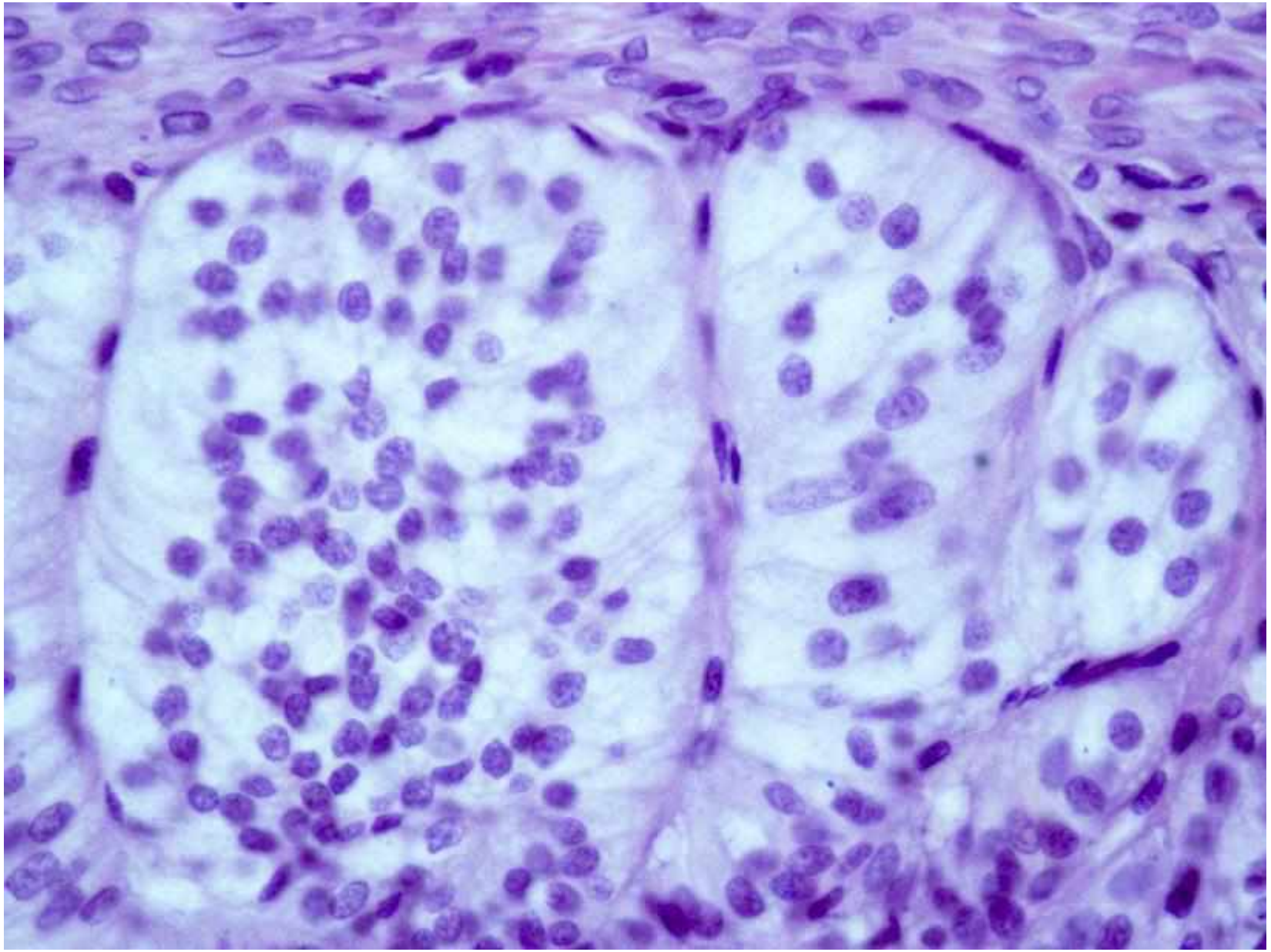
Slide №112 “Adrenal gland, H&E”



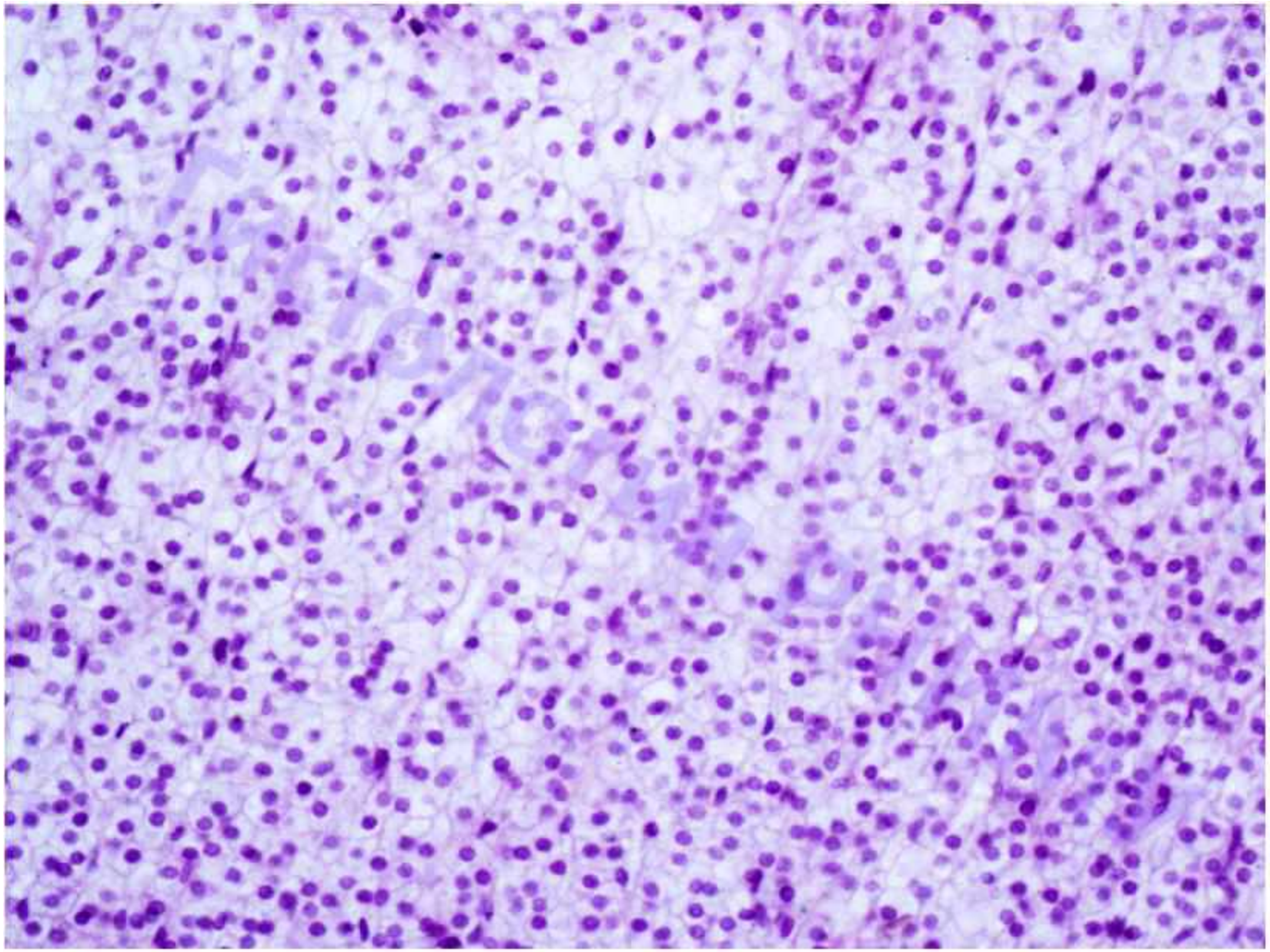
Slide №112 "Adrenal gland, H&E"



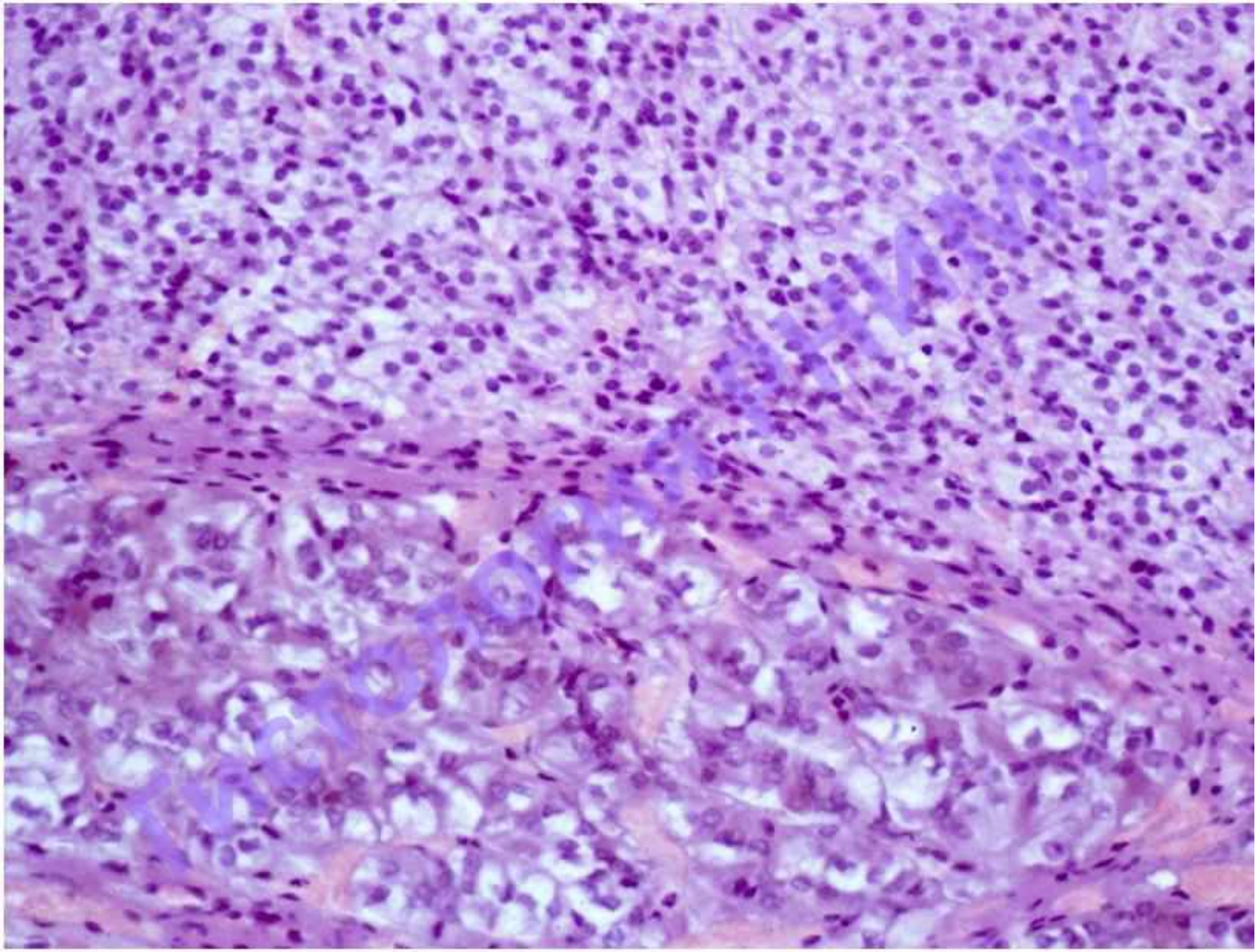
Slide №112 “Adrenal gland, H&E”



Slide №112 “Adrenal gland, H&E”



*Slide №112 "*Adrenal gland, H&E"



*Slide №112 "*Adrenal gland, H&E"