

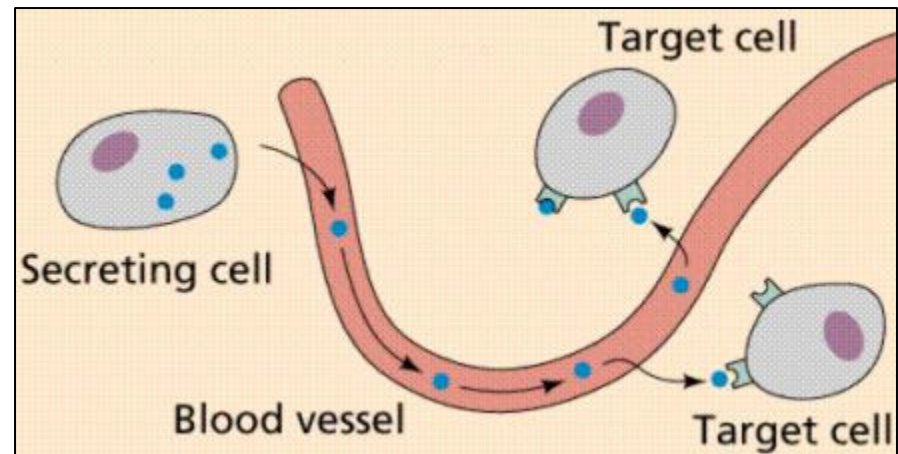
# Sistema Endócrino

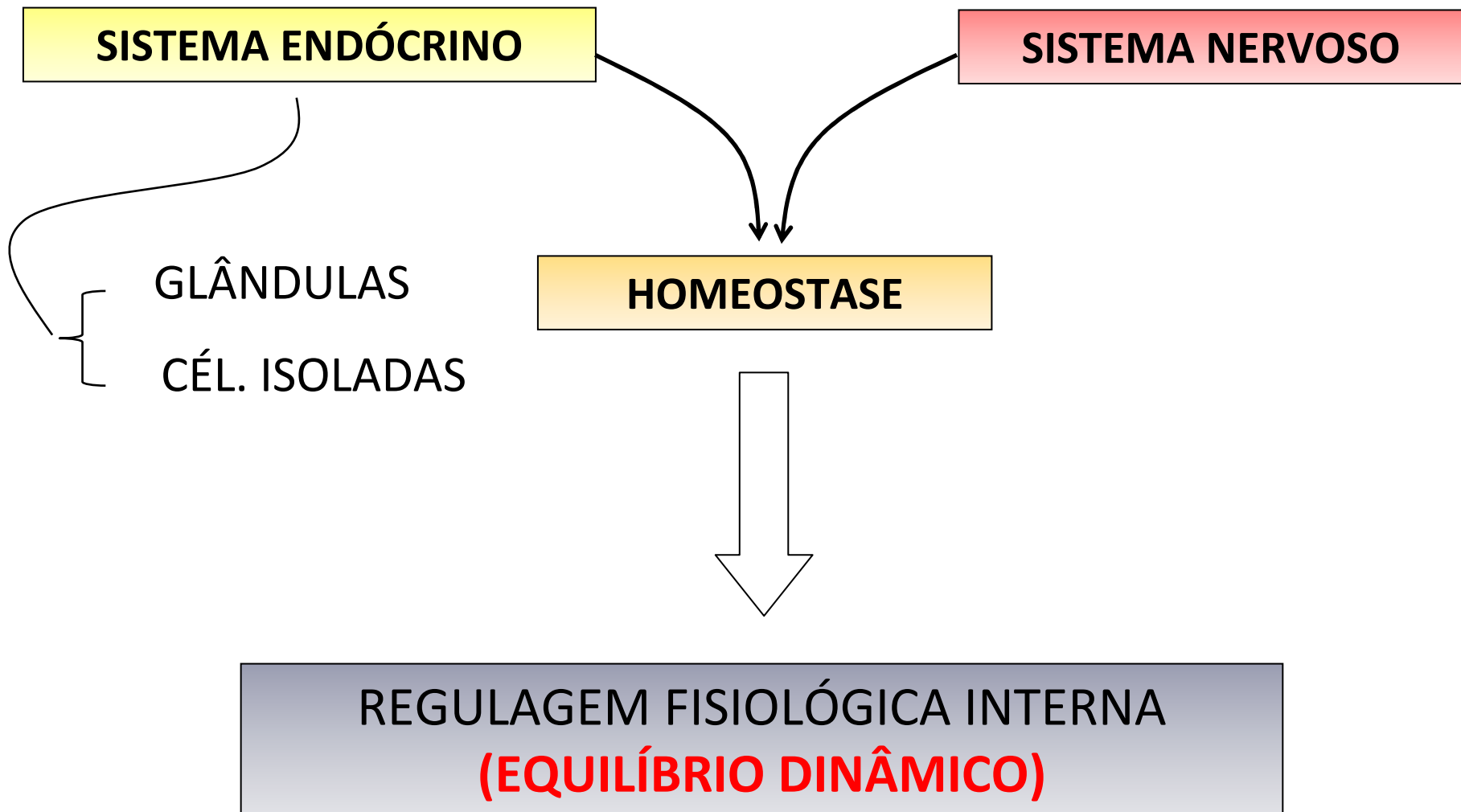
## Sistema Endócrino

- Células isoladas: Células APUD
- Partes de glândula mista (ilhotas pancreáticas)
- Glândulas propriamente ditas

## Glândulas Endócrinas

- sem ductos
- secreção endócrina/parácrina/autócrina
- órgão(s) alvo (s): receptor específico
- hormônios
  - esteróides
  - polipeptídicos
  - protéicos
  - glicoprotéicos





# MECANISMO DE CONTROLE HORMONAL

**CONTROLE AUTÓCRINO:** hormônios agem nas próprias células ou em células do mesmo tipo - IGF

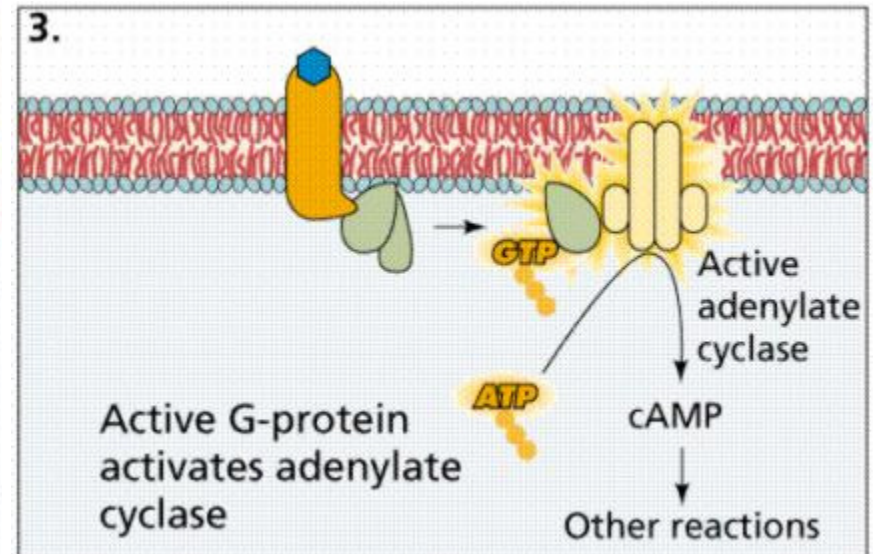
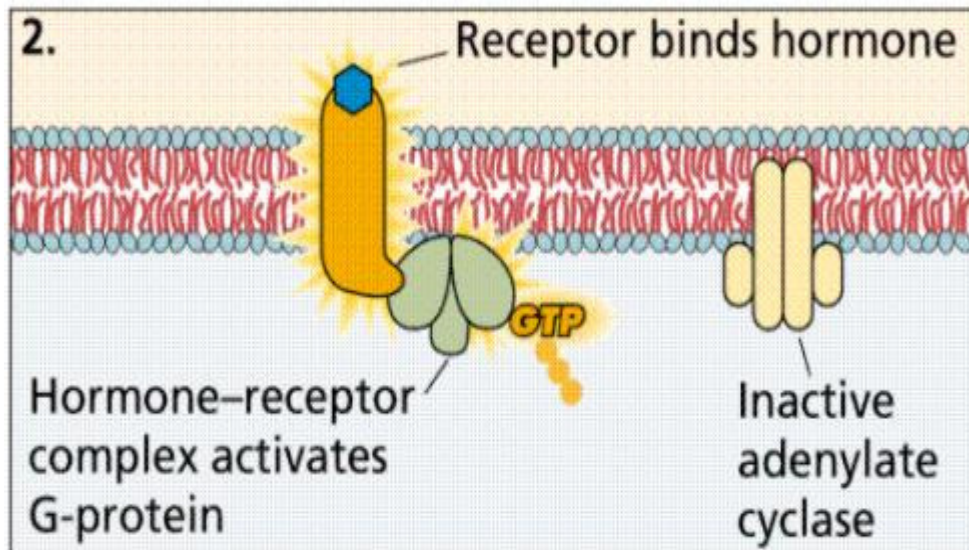
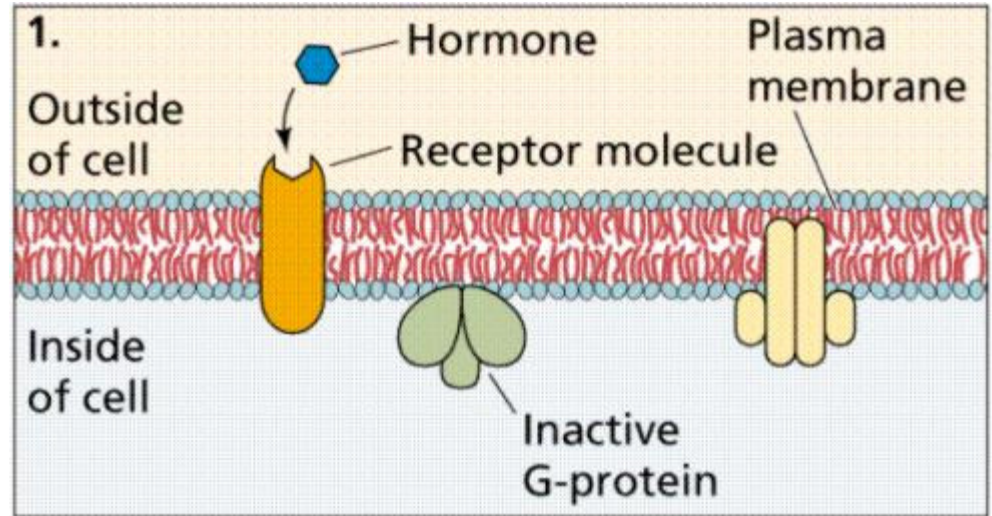
**CONTROLE PARÁCRINO:** hormônio é conduzido por curto trajeto até a célula-alvo – gastrina, somatostatina

**CONTROLE ENDÓCRINO:** hormônio é liberado na matriz extracelular – sangue - células-alvo (maioria dos hormônios)

# Sistema Endócrino

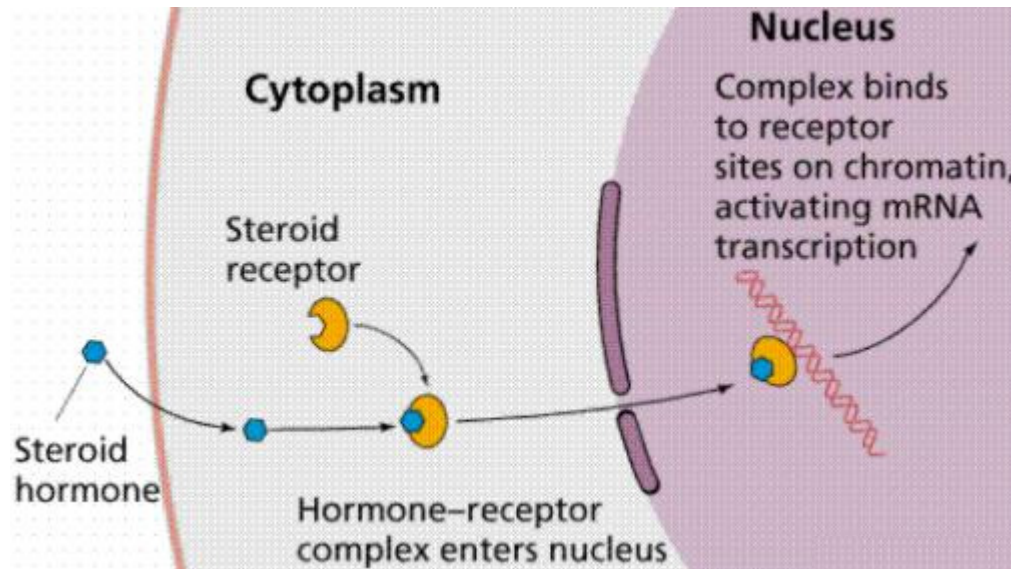
## Hormônio- Receptor celular: mecanismo de ação

Hormônios não esteróides

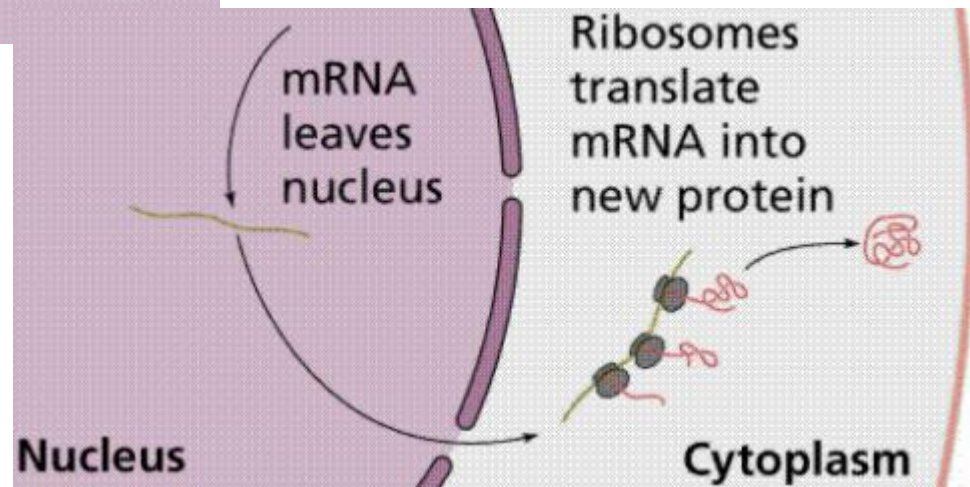


# Sistema Endócrino

## Hormônio- Receptor celular: mecanismo de ação

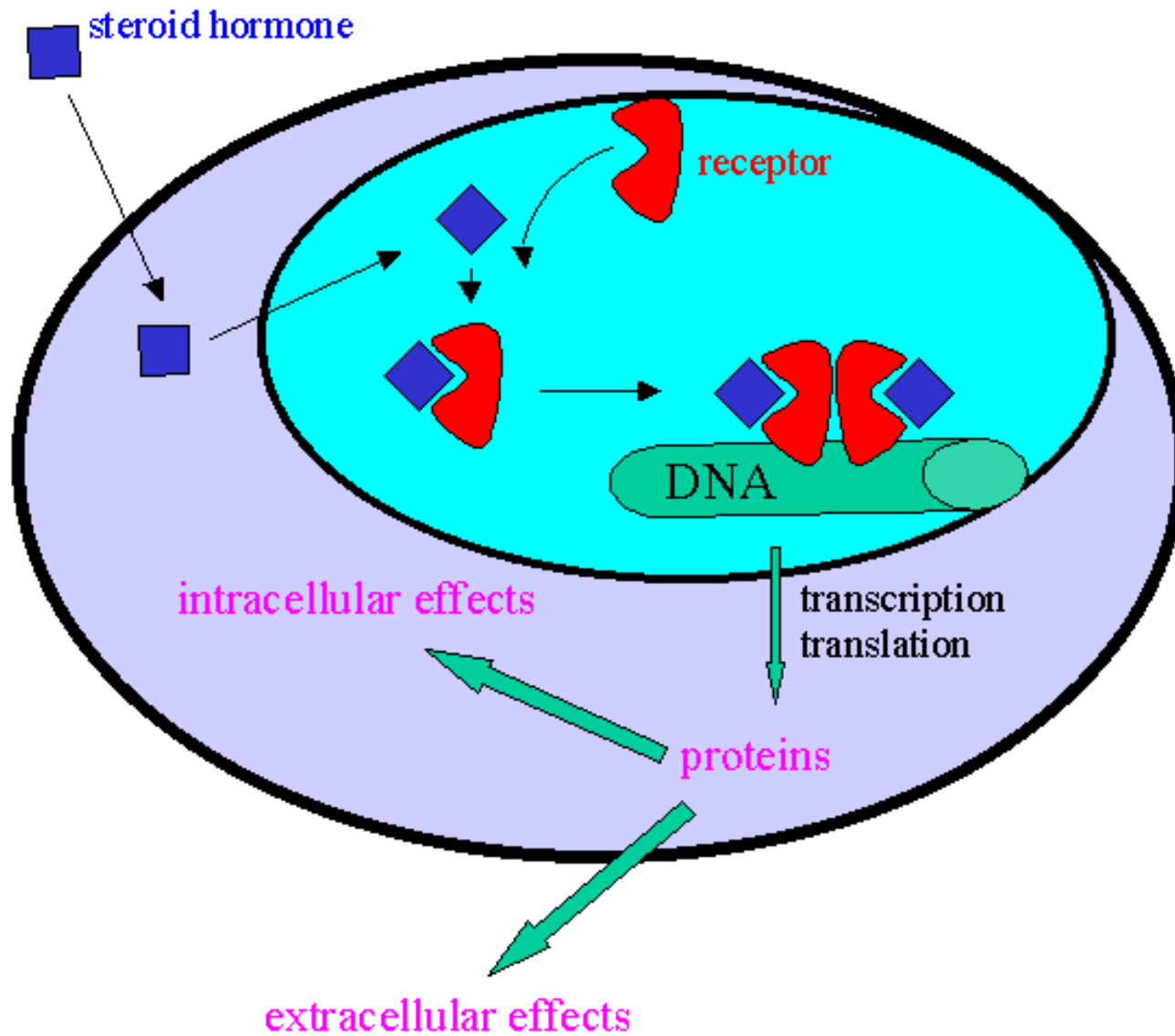


## Hormônios esteróides



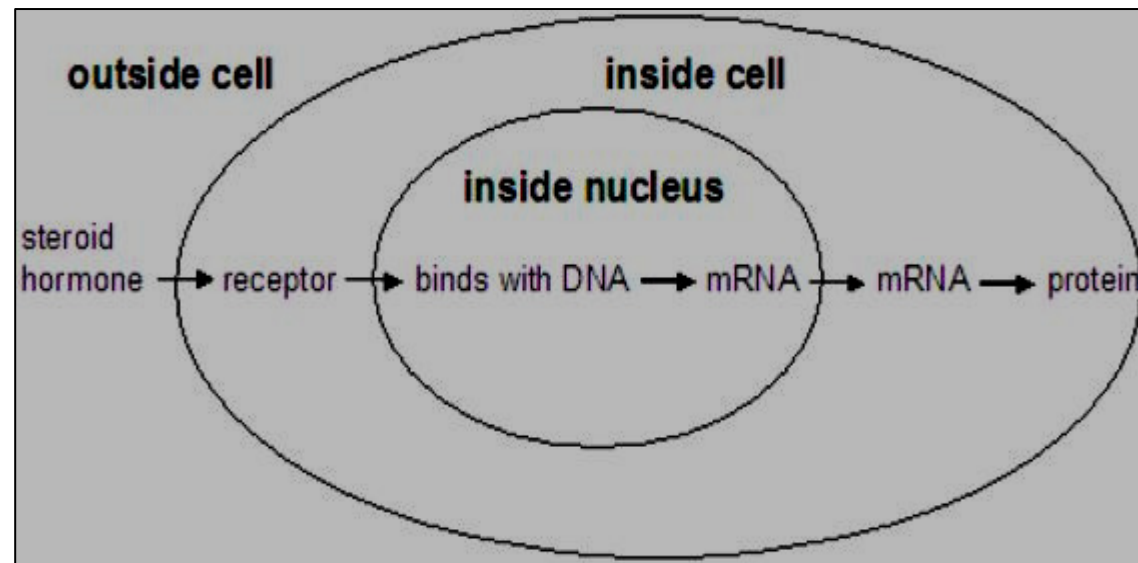
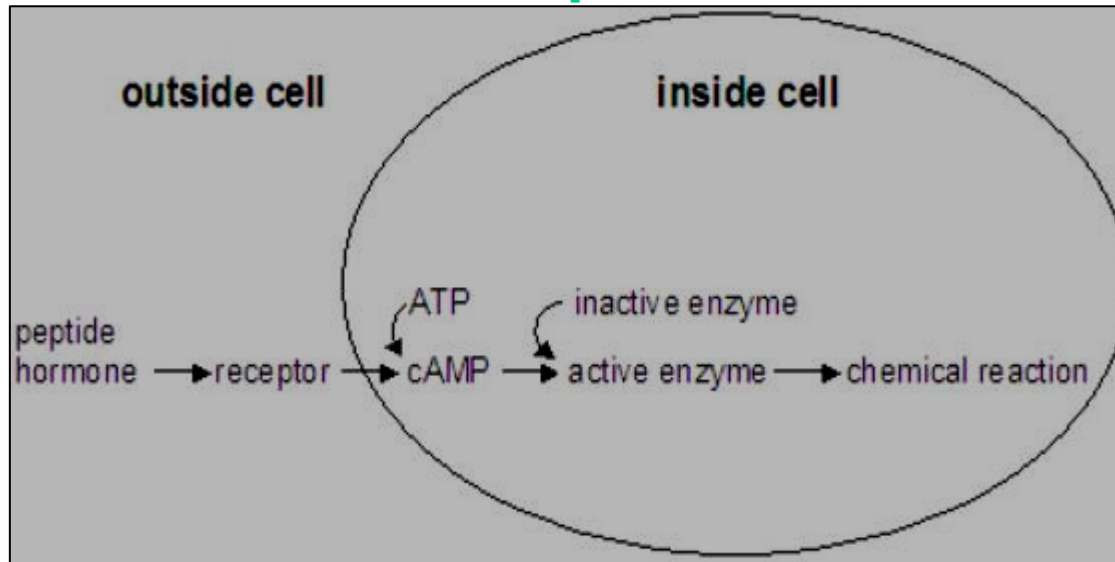
# Sistema Endócrino

## Hormônio- Receptor celular: mecanismo de ação



# Sistema Endócrino

## Hormônio- Receptor celular: mecanismo de ação



# Sistema Endócrino

## ➤ Glândulas endócrinas clássicas

### Número de células

- multicelulares

pineal, paratireóide, tireóide, adrenal, hipófise

- unicelulares

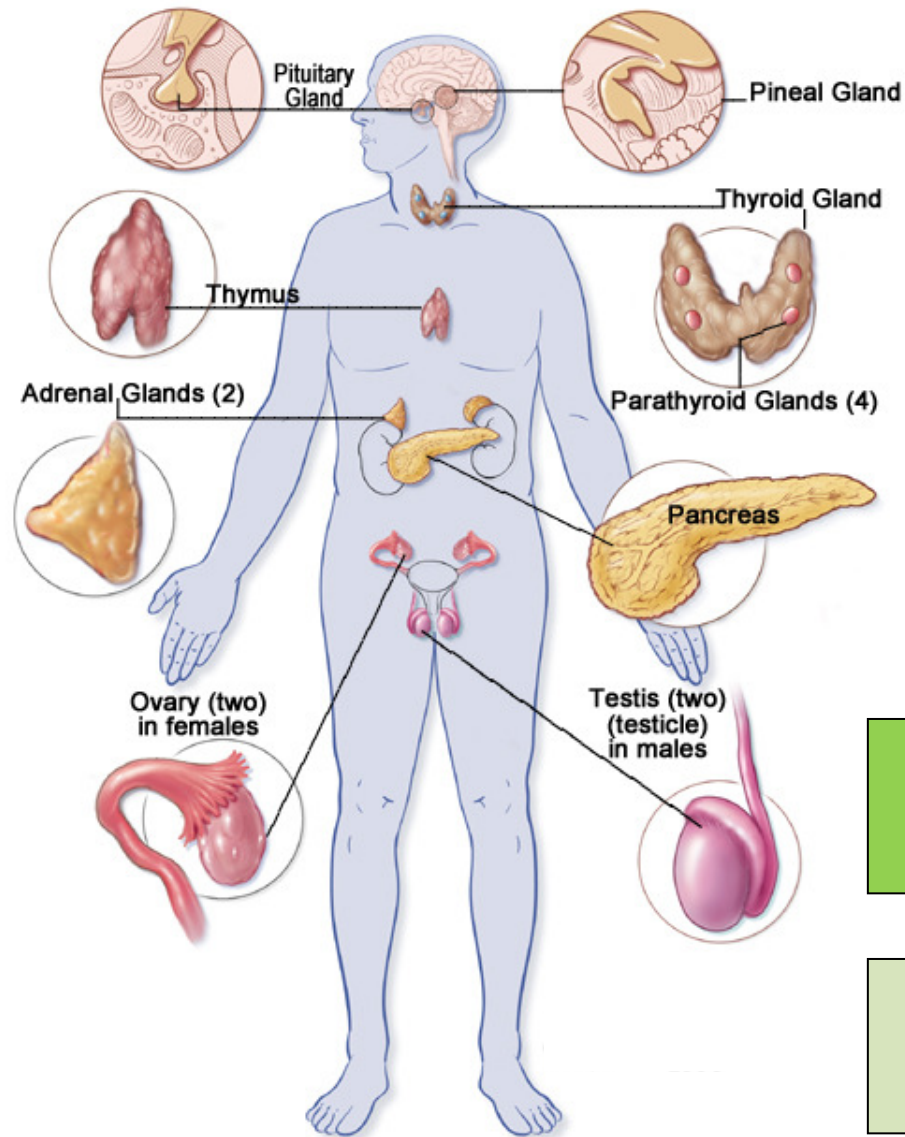
sistema neuroendócrino difuso

### Morfologia

- vesicular ou folicular
- cordonal



# GLÂNDULAS ENDÓCRINAS



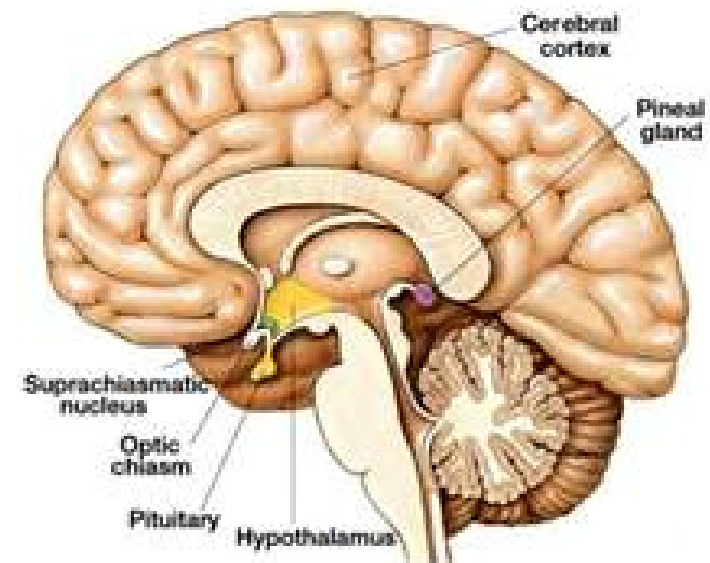
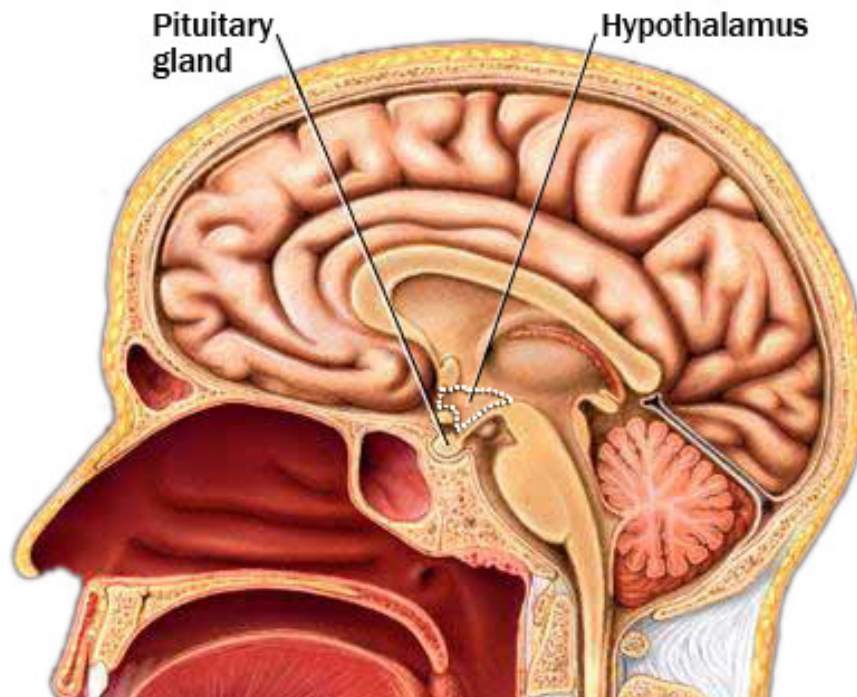
**Glândulas Endócrinas**  
(organismo inteiro)

**Células Enteroendócrinas**  
(isoladas no T. Digestório)

# Sistema Endócrino

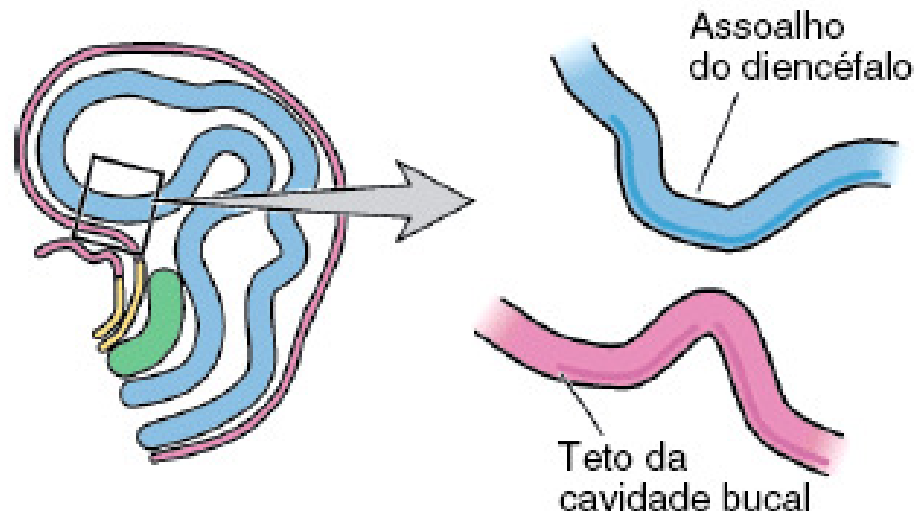
## Hipófise (pituitária)

- base do cérebro: associada ao hipotálamo (sella túrcica)
- epitelial = adenohipófise (estomodeo)
- nervosa = neurohipófise (diencéfalo primitivo)



Hipófise:

Origem embriológica



epitelial = **adenohipófise** (estomodeo)

nervosa = **neurohipófise** (diencefalo primitivo)

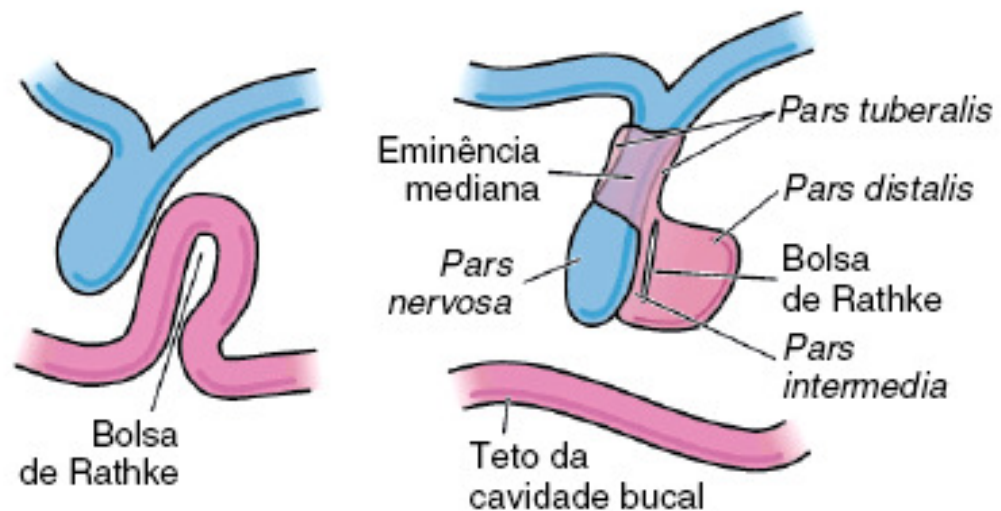


Fig. 20.1 Desenvolvimento embrionário da adeno-hipófise e da neuro-hipófise a partir do ectoderma do teto da cavidade oral e do assoalho do diencefalo.

# Sistema Endócrino

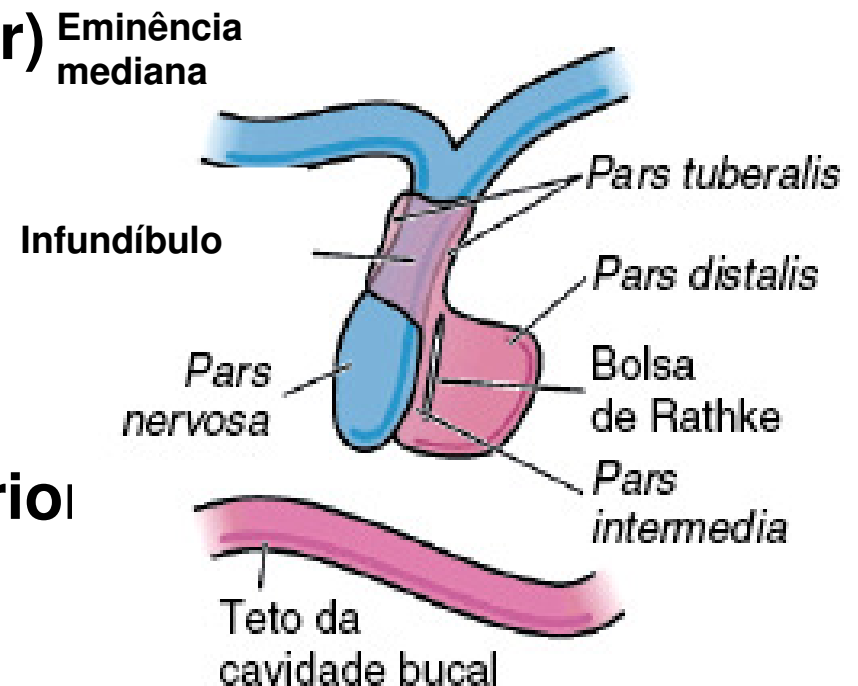
## Hipófise (pituitária)

### Adenohipófise

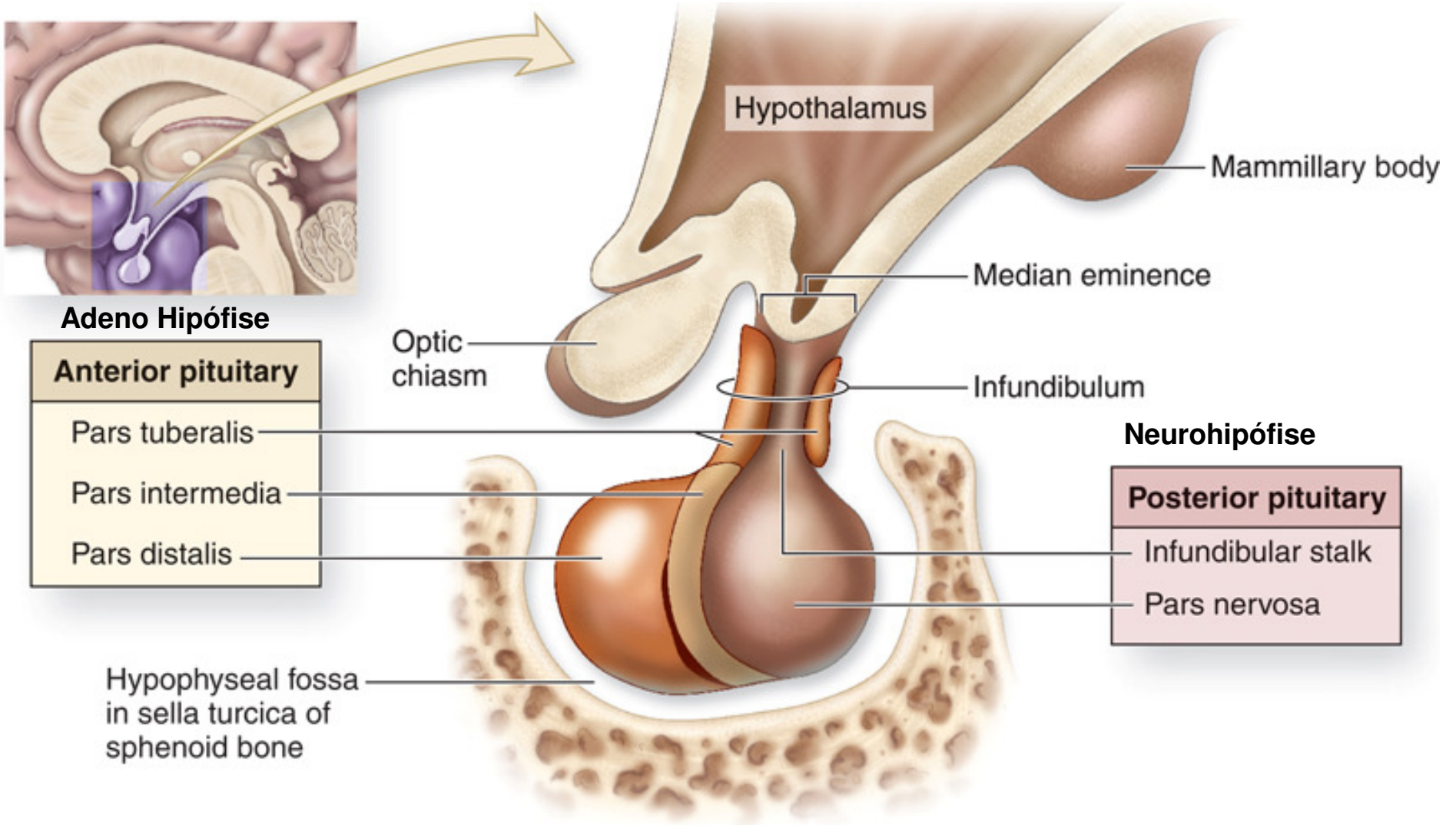
- Pars distalis (hipófise anterior)
- Pars intermedia,
- Pars tuberalis

### Neurohipófise

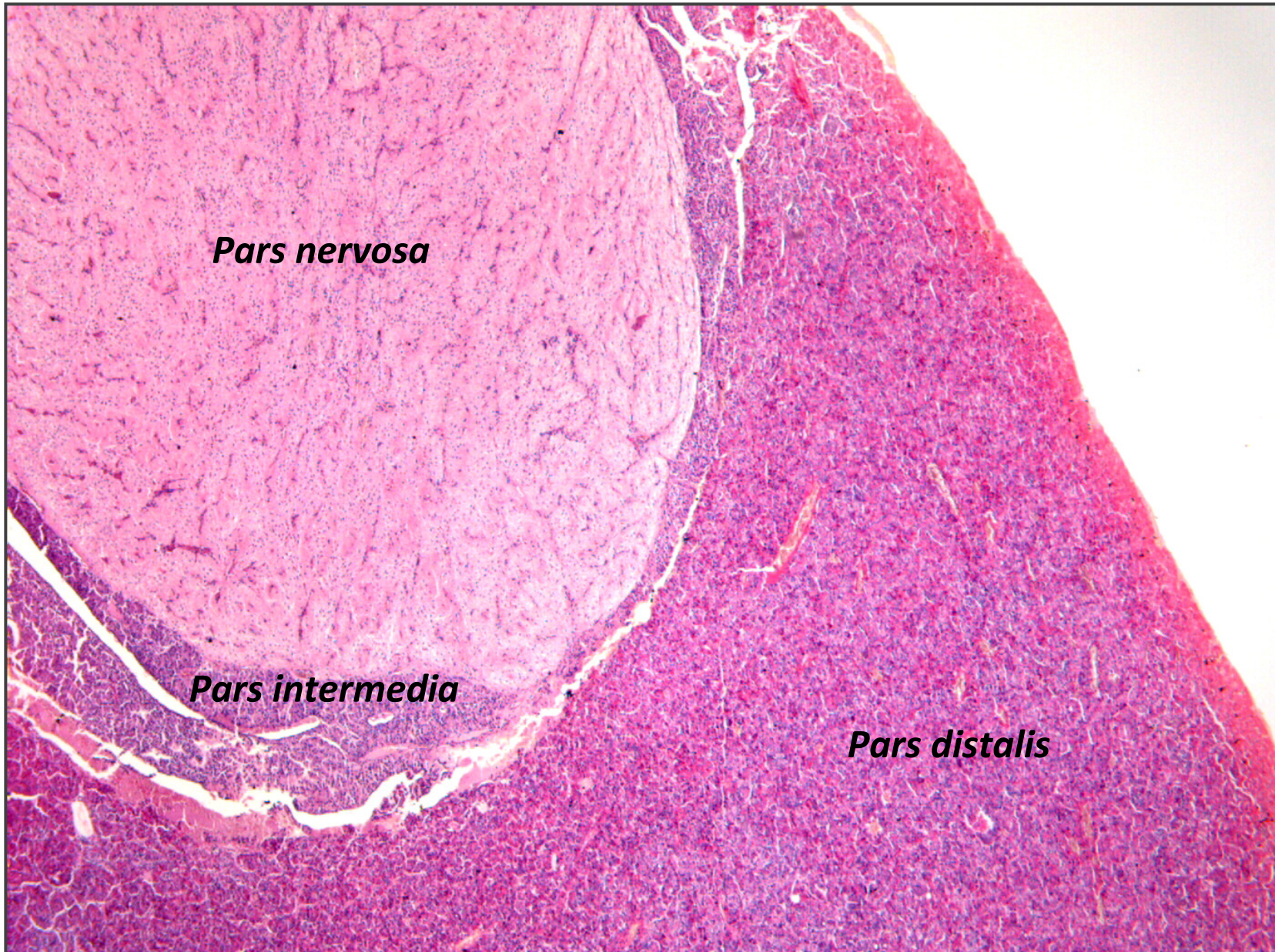
- Pars nervosa (hipófise posterior)
- Infundíbulo
- Eminência Média

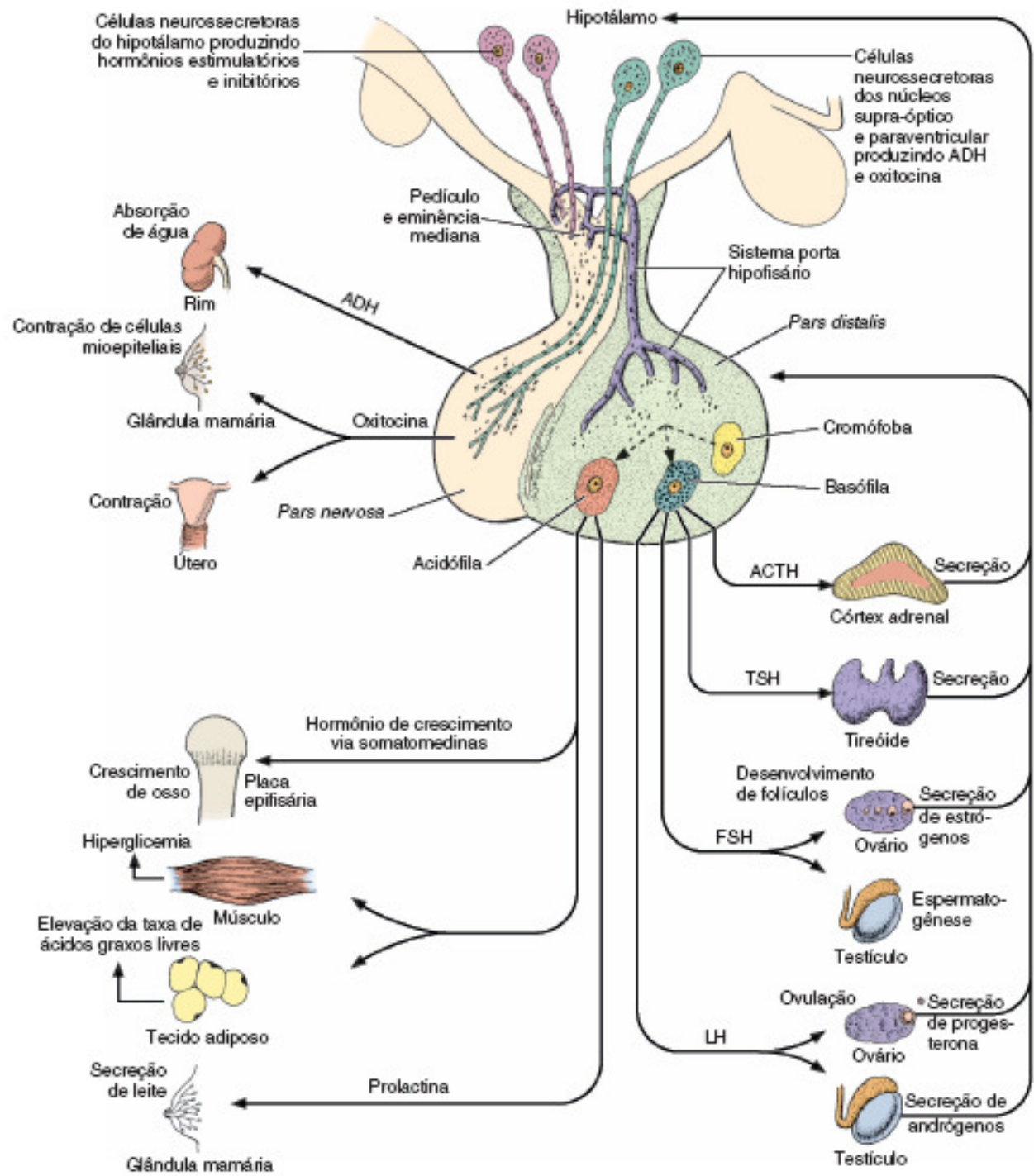


# Hipófise (pituitária)



# Hipófise (pituitária)





# Sistema Endócrino

Adenohipófise: Glândula endócrina cordonal: tipos de células

## Pars distalis

### Cromófilas

#### Células acidófilas

- somatotróficas- GH
- mamotrólicas ou lactotrólicas (prolactina)

#### Células basófilas

- adenocorticolipotrólicas – ACTH, lipotrofinas
- tireotrólicas - TSH
- gonadotrólicas – FSH, LH

Cromófobas – sem secreção



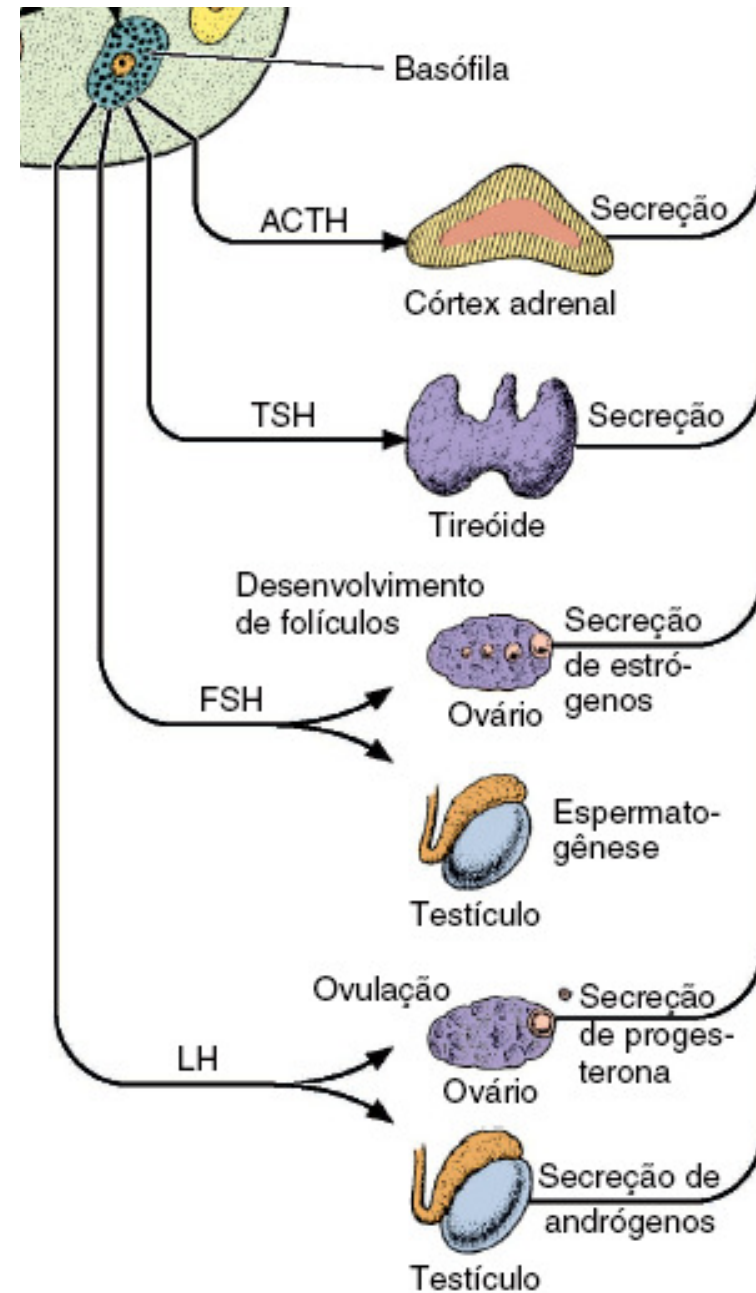
# Sistema Endócrino

## Adenohipófise: tipos de células

### Pars distalis

#### Cromófilas basófilas

- adenocorticolipotróficas – ACTH
- tireotróficas - TSH
- gonadotróficas – FSH, LH



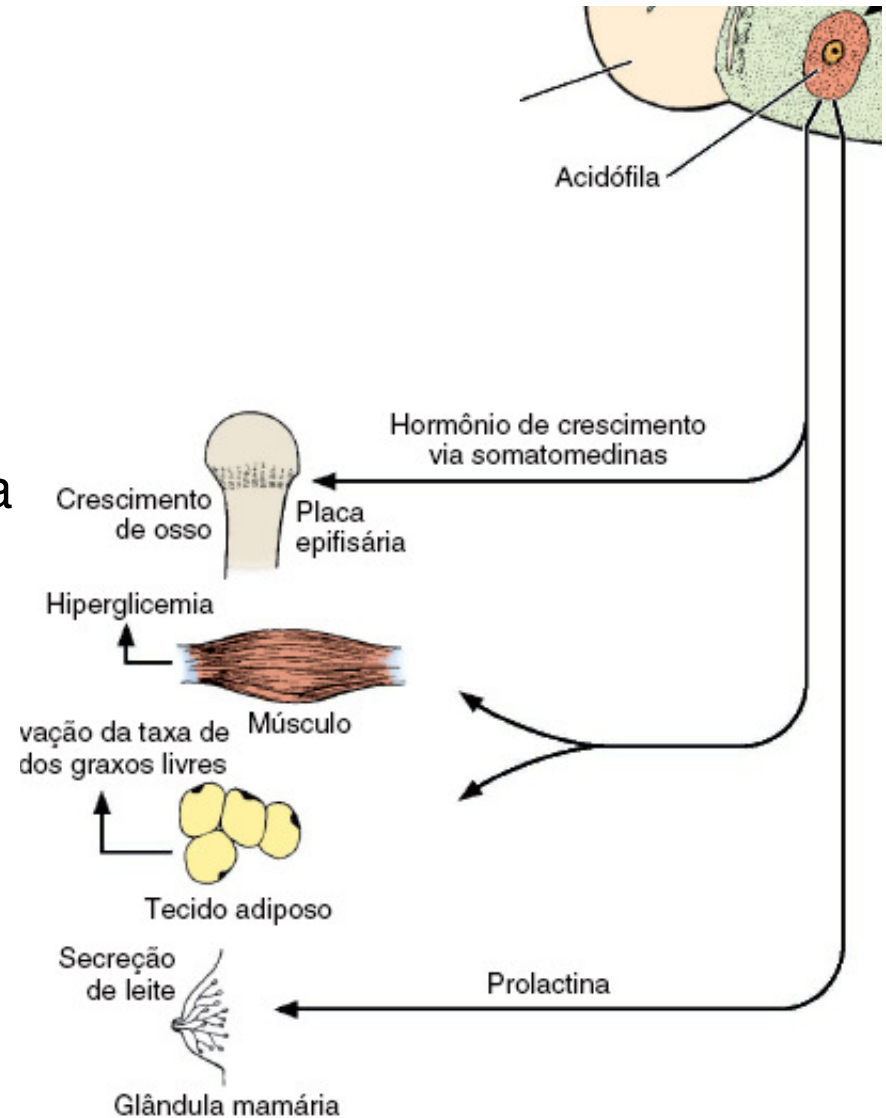
# Sistema Endócrino

## Adenohipófise: tipos de células

### Pars distalis

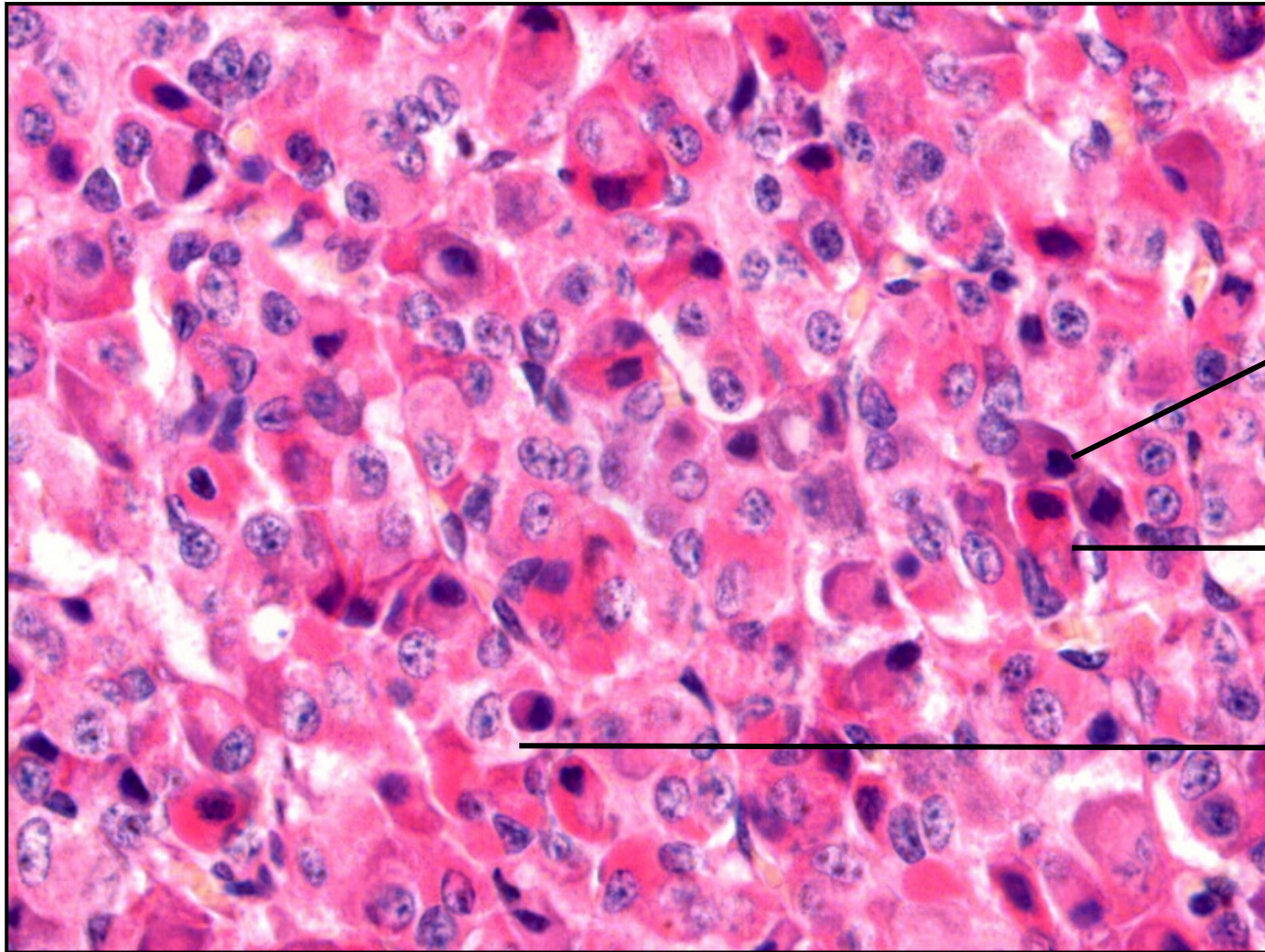
### Cromófilas acidófilas

- Somatotróficas - GH
- mamotrólicas ou lactotrólicas - Prolactina



# Sistema Endócrino

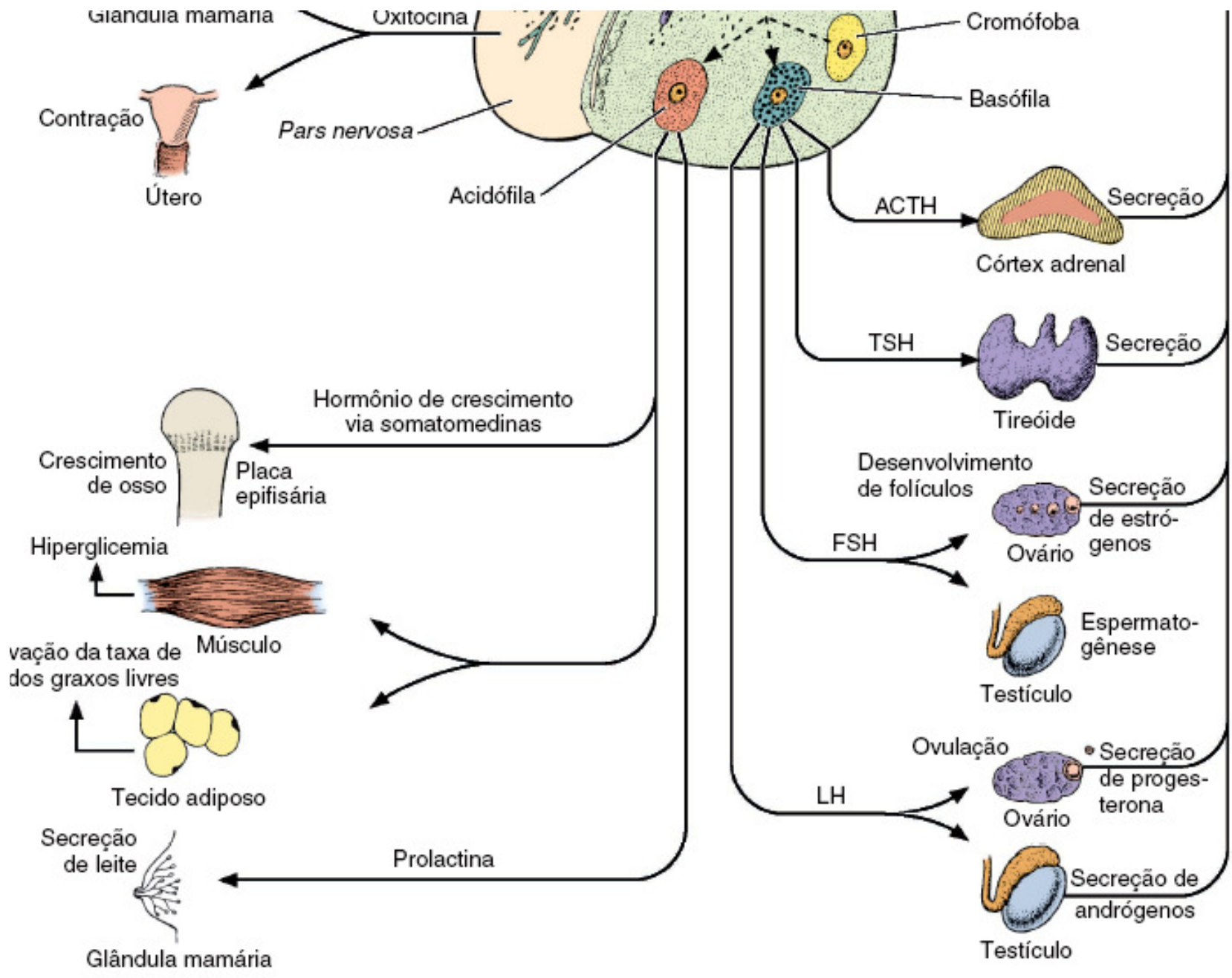
## Adenohipófise



**CROMÓFILA  
BASÓFILA**

**CROMÓFILA  
ACIDÓFILA**

**CROMÓFOBA**



# Sistema Endócrino

## ➤ Adenohipófise

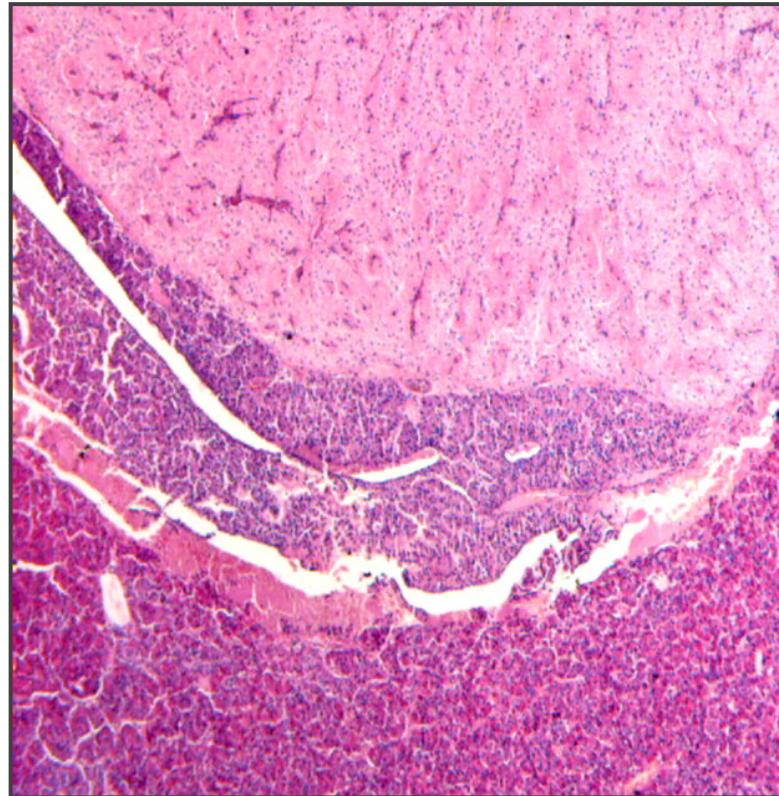
### Pars intermedia

Células cromófilas

Células basófilas

- melanotróficas - MST (H. melanotrófico)
- vesículas com colóide (resquício da bolsa de Rathke)

Células cromófobas



# Sistema Endócrino

## ➤ Adenohipófise

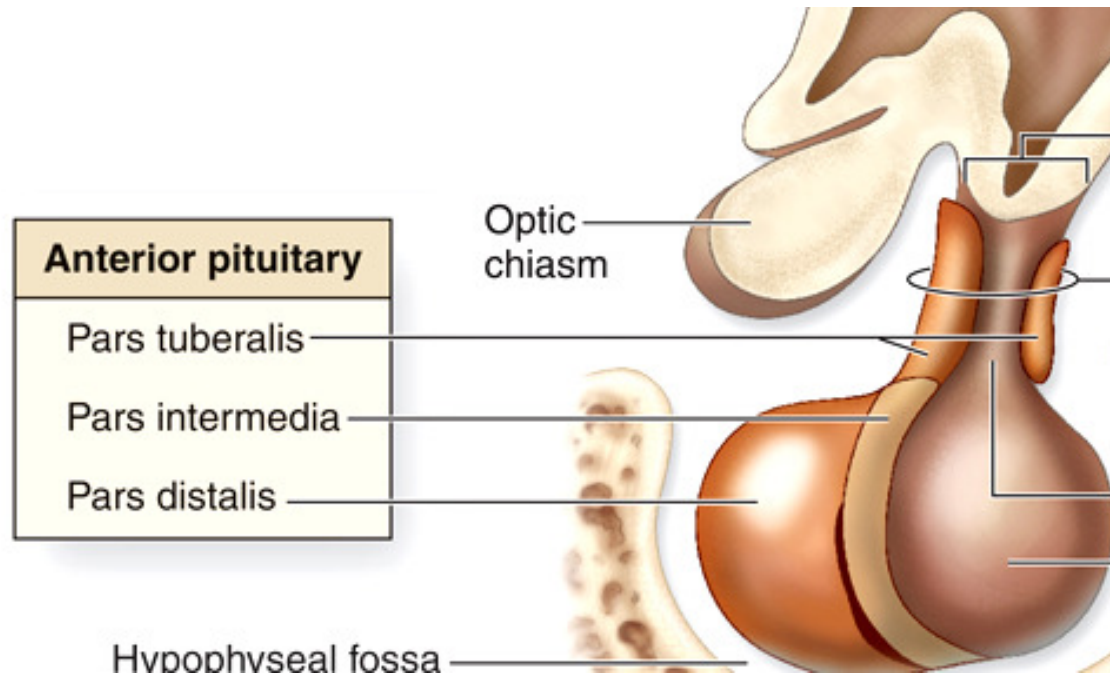
### Pars tuberalis

Células cromófilas

Células basófilas

- gonadotróficas – FSH, LH

Células cromófobas



# CONTROLE FUNCIONAL DA *PARS DISTALIS*

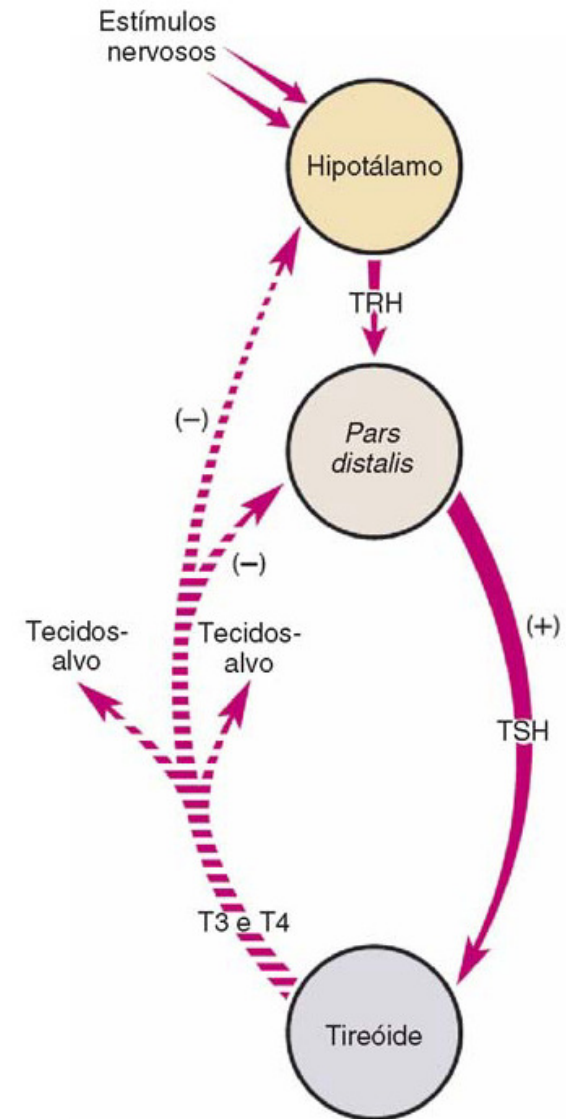
## Produção do TSH – Hormônio Estimulante da Tireóide

✓ Mecanismo principal: **HIPOTÁLAMO**

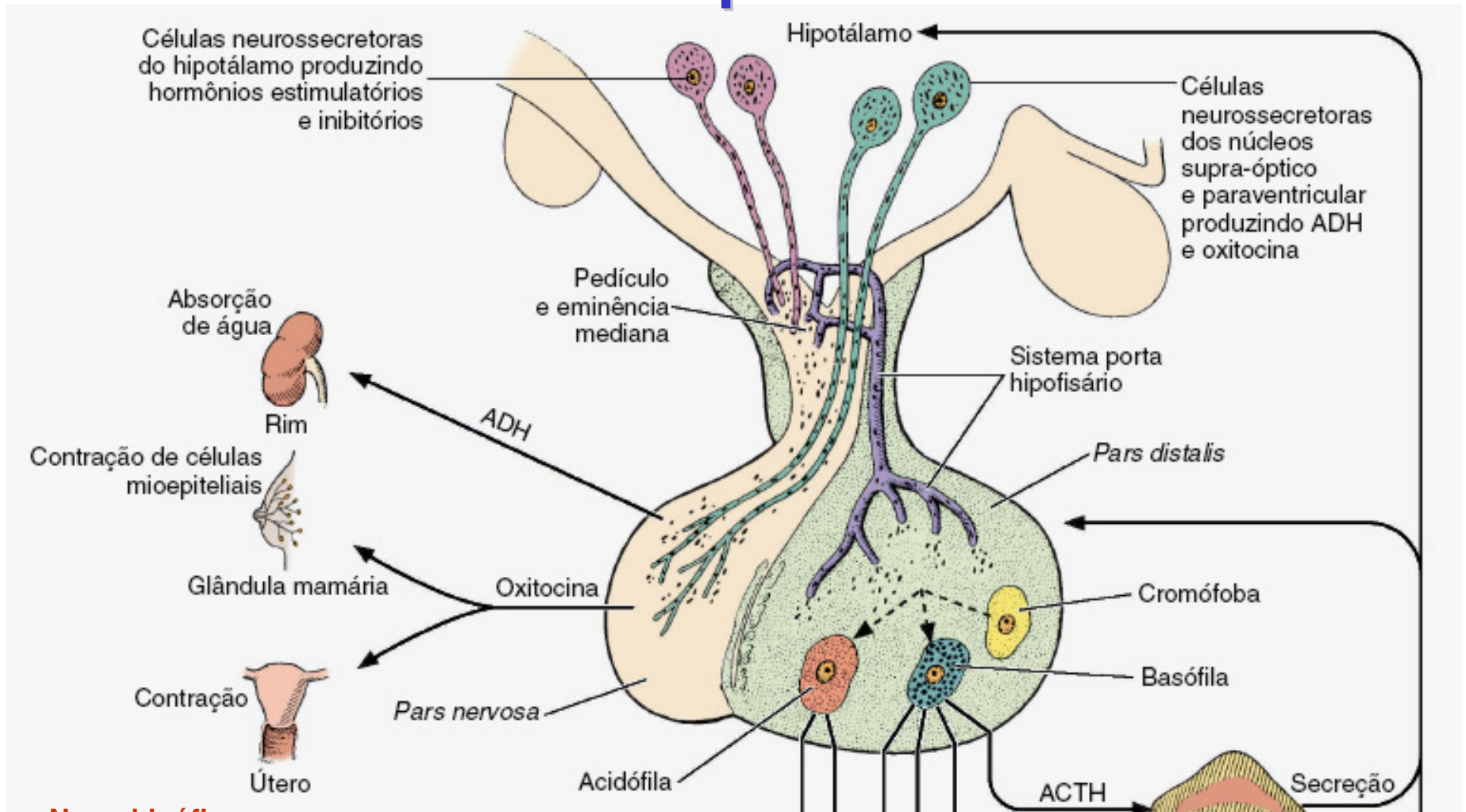


HORMÔNIOS LIBERADORES  
HIPOTALÂMICOS

✓ Mecanismo de *Feedback*



# Neurohipófise



## Neurohipófise

- Pars nervosa (hipófise posterior)
- Infundíbulo
- Eminência Média



# Sistema Endócrino

## ➤ Neurohipófise

### Componentes:

#### Fibras amielínicas

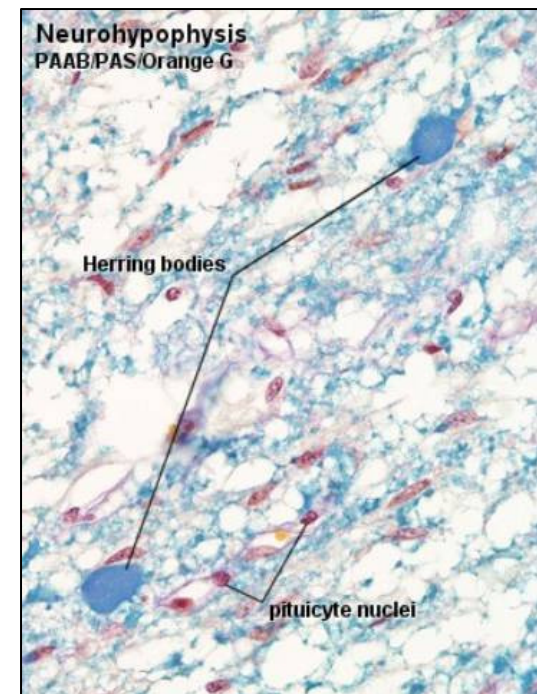
- corpos de Herring (oxitocina, ADH- neurofisinas)
- origem – corpos celulares de neurônios dos núcleos paraventricular e supra-óptico

#### Pituícitos (células estruturais)

#### Capilares fenestrados

#### Neurohipófise

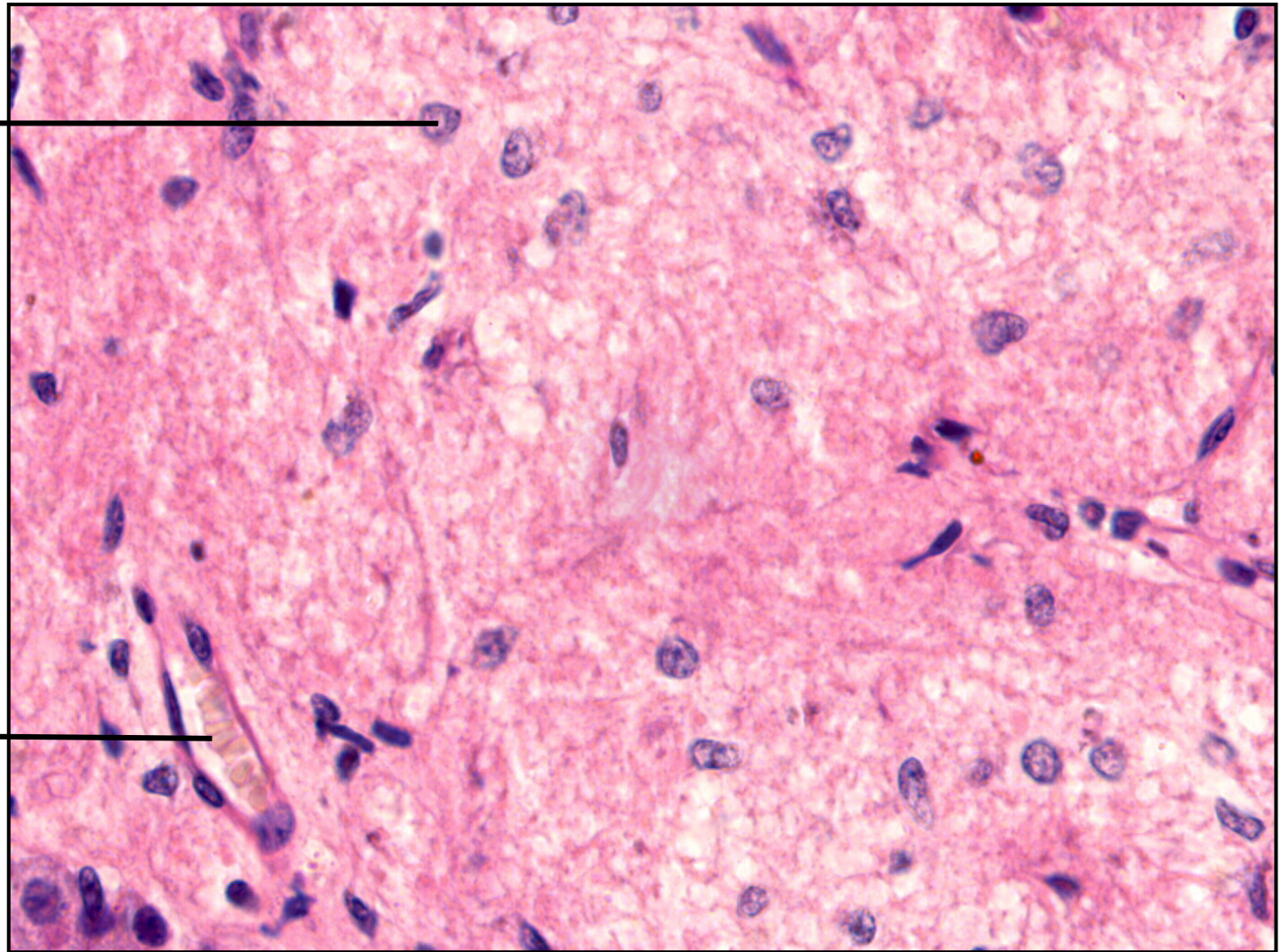
- Pars nervosa (hipófise posterior)
- Infundíbulo
- Eminência Media



# NEURO-HIPÓFISE

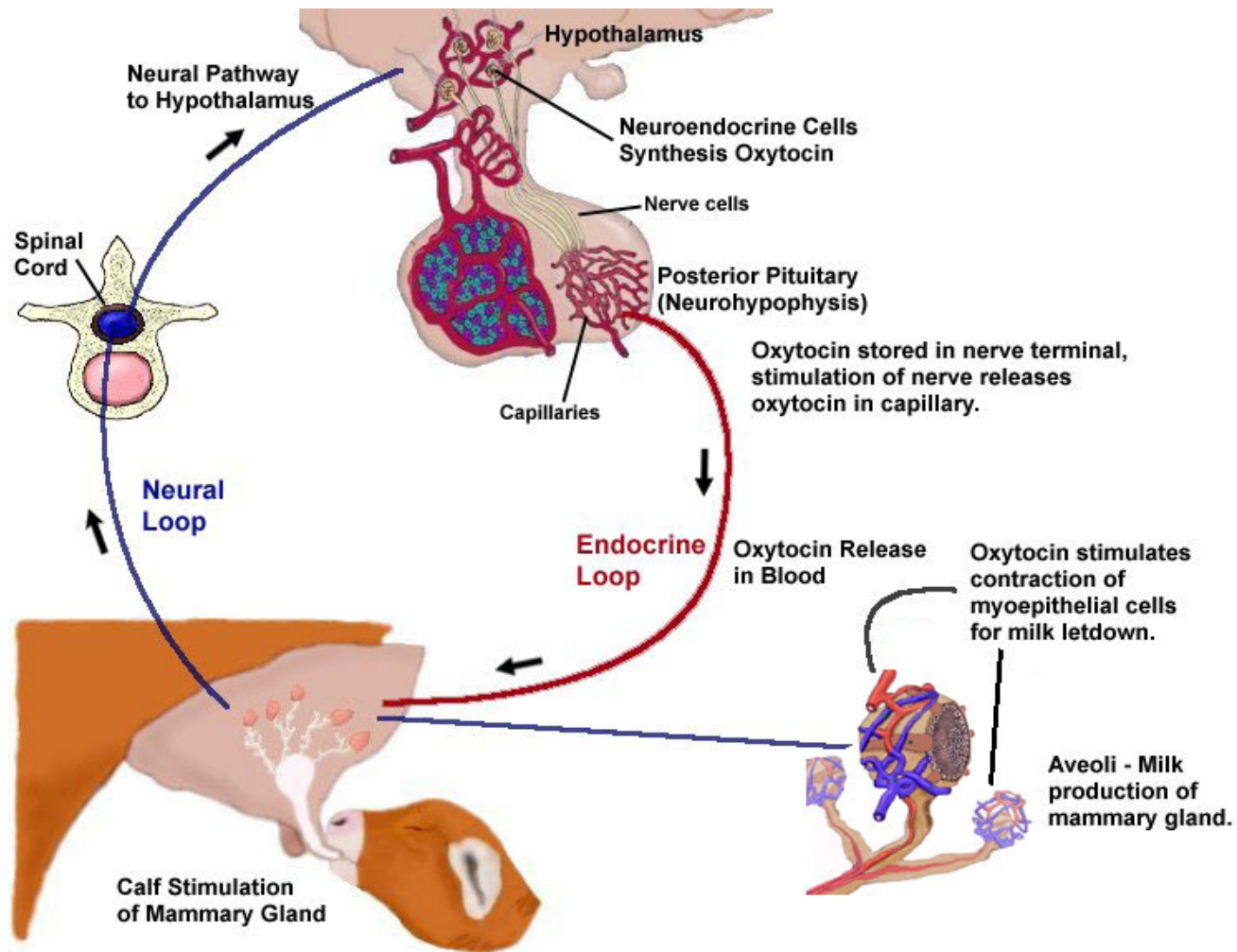
Pituícitos  
(Glial)

Vasos

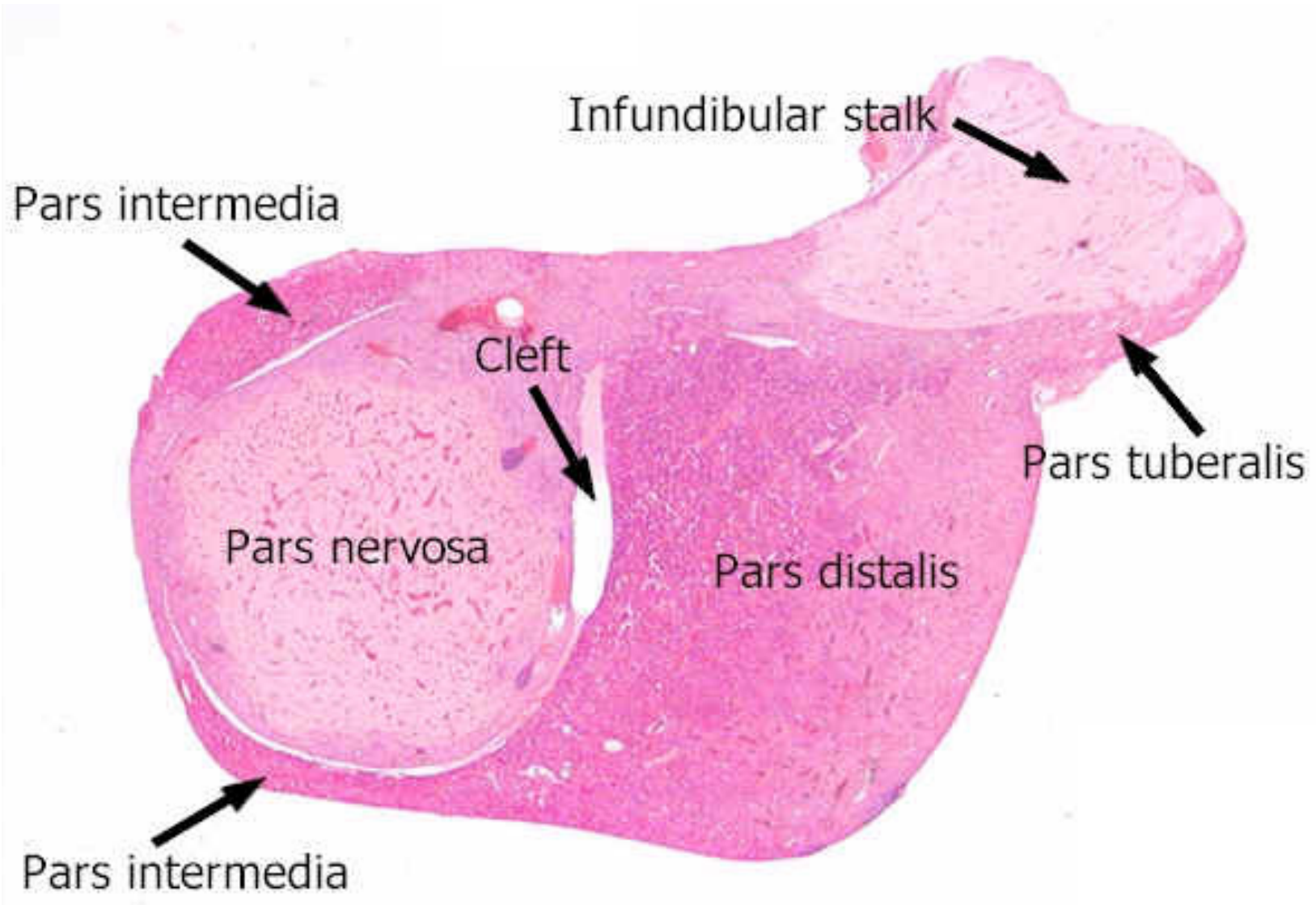


# CONTROLE FUNCIONAL DA *PARS NERVOSA*

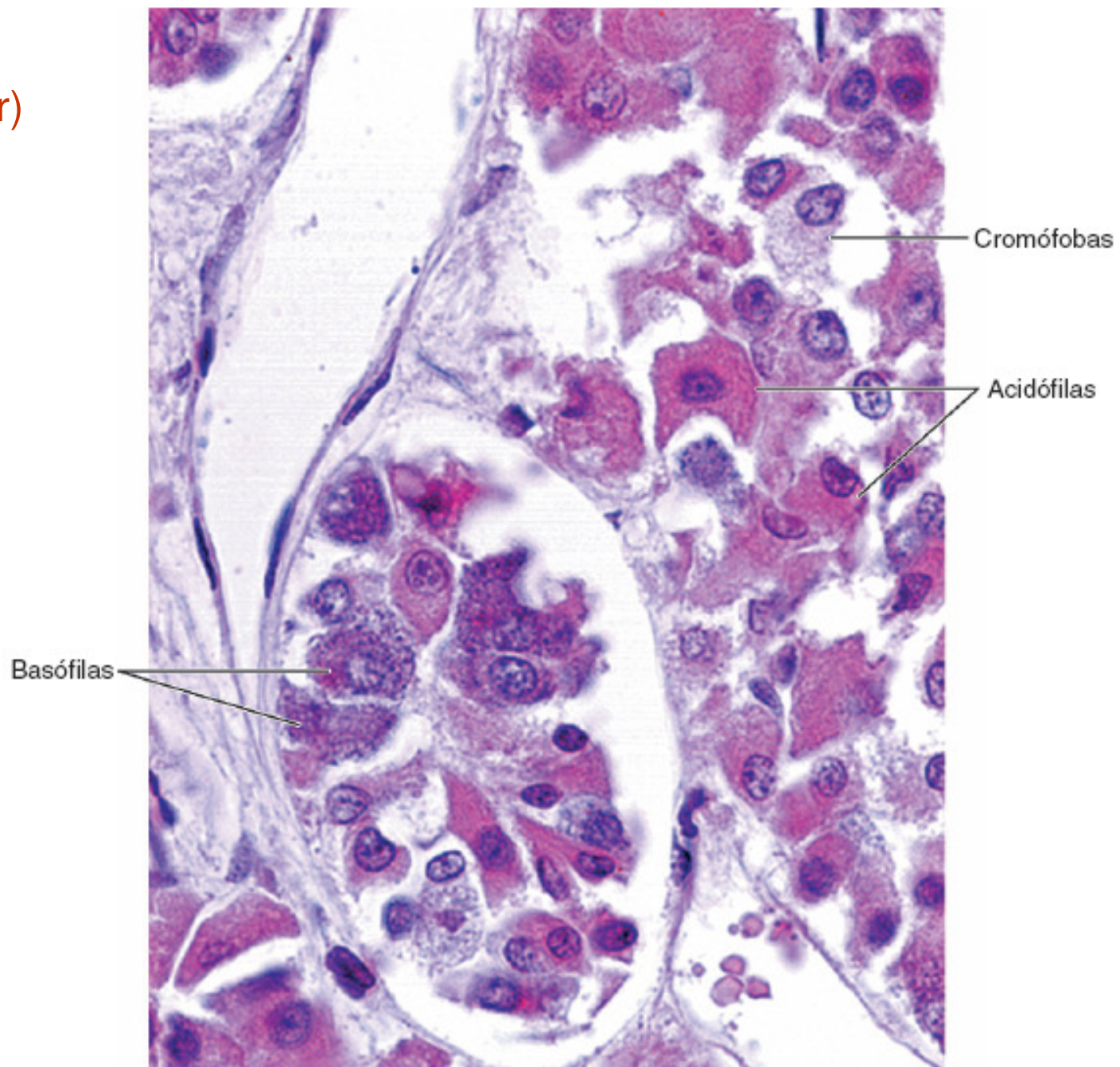
## Produção de Leite - OXITOCINA



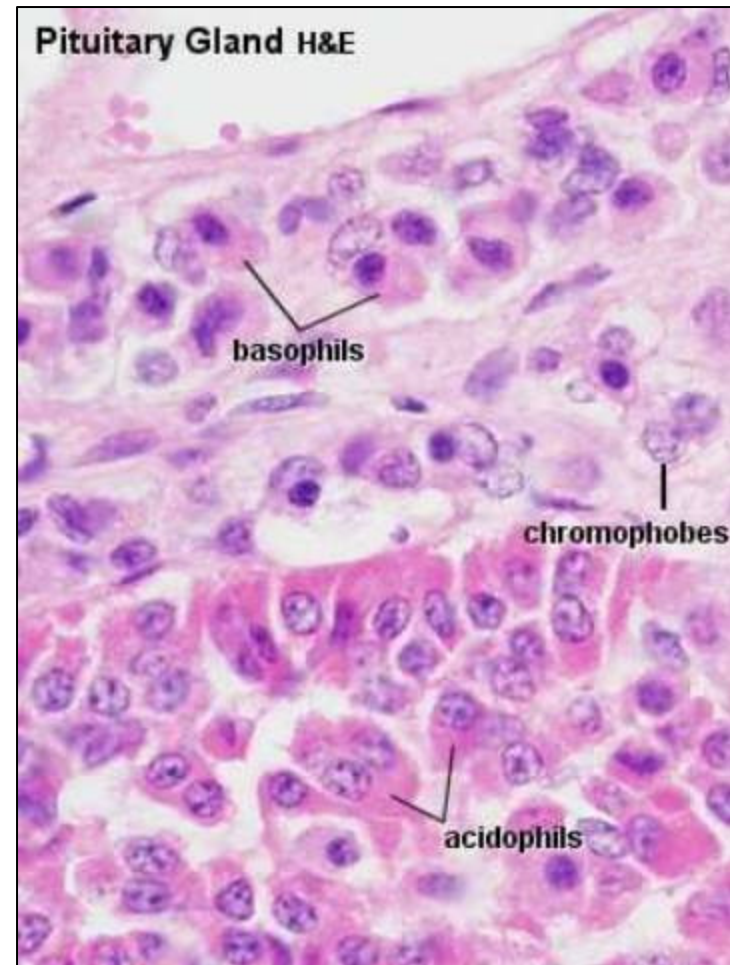
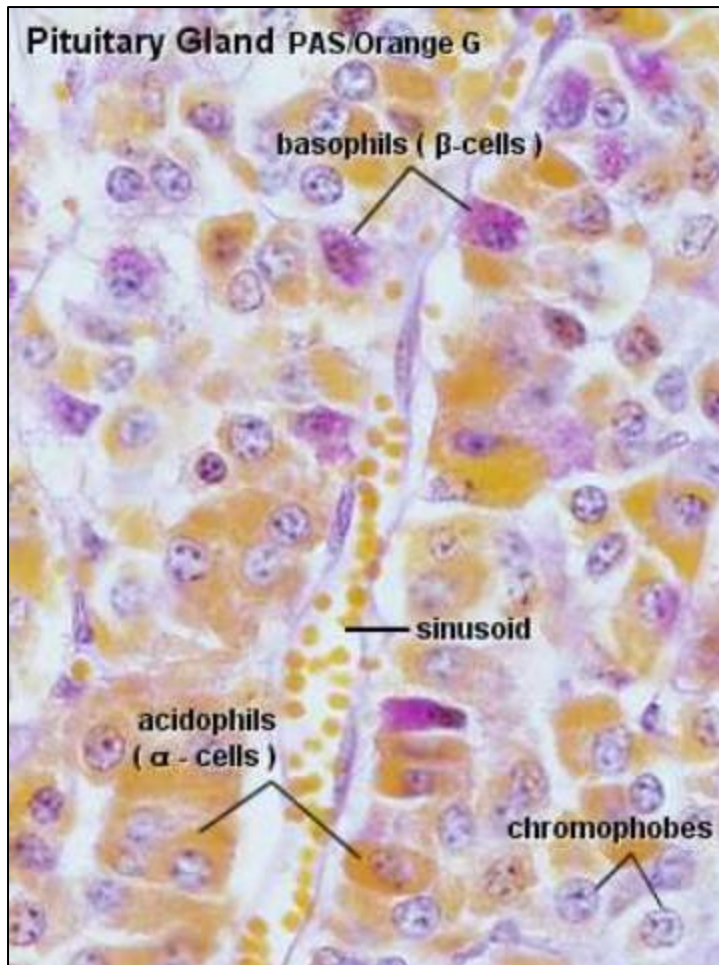
# Hipófise



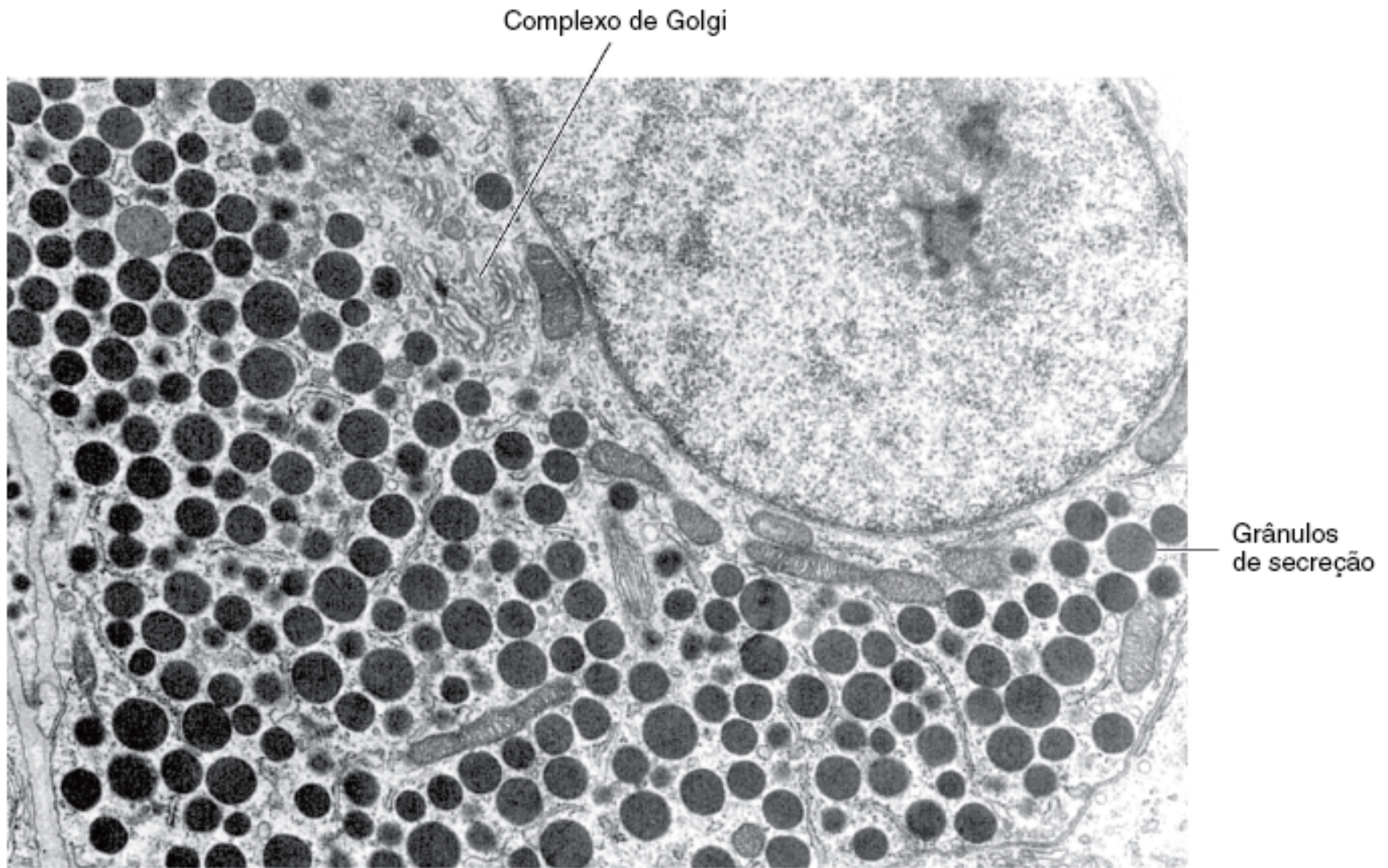
Pars distalis  
(hipófise anterior)



## Pars distalis (hipófise anterior)

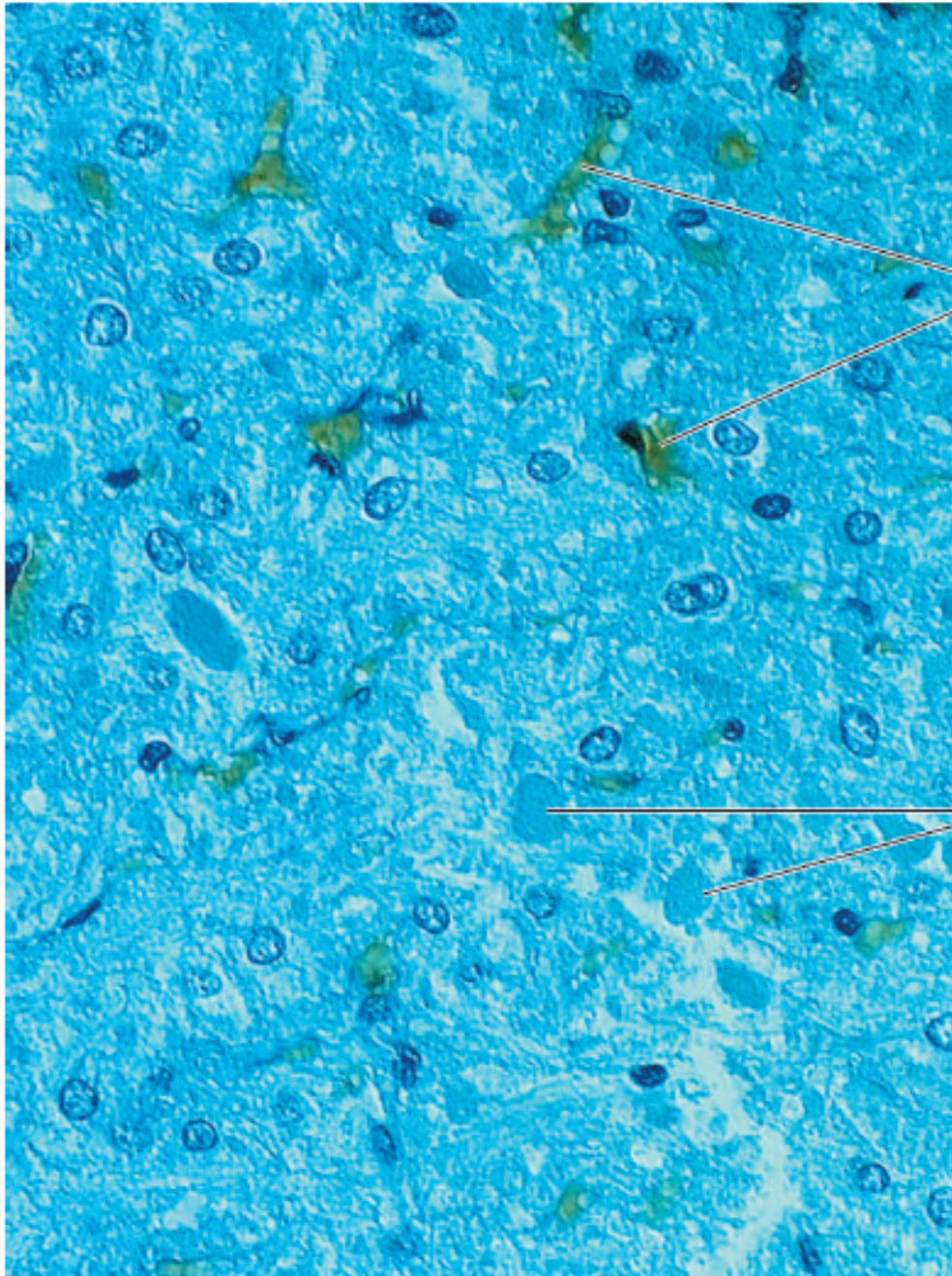


## Pars distalis (hipófise anterior)



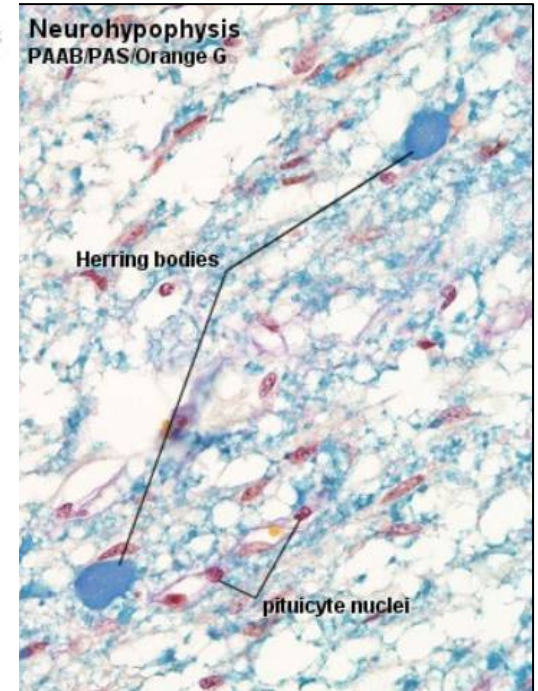
Célula somatotrófica: acidófila

# Pars nervosa (hipófise posterior)



Capilares sanguíneos

Corpos de Herring



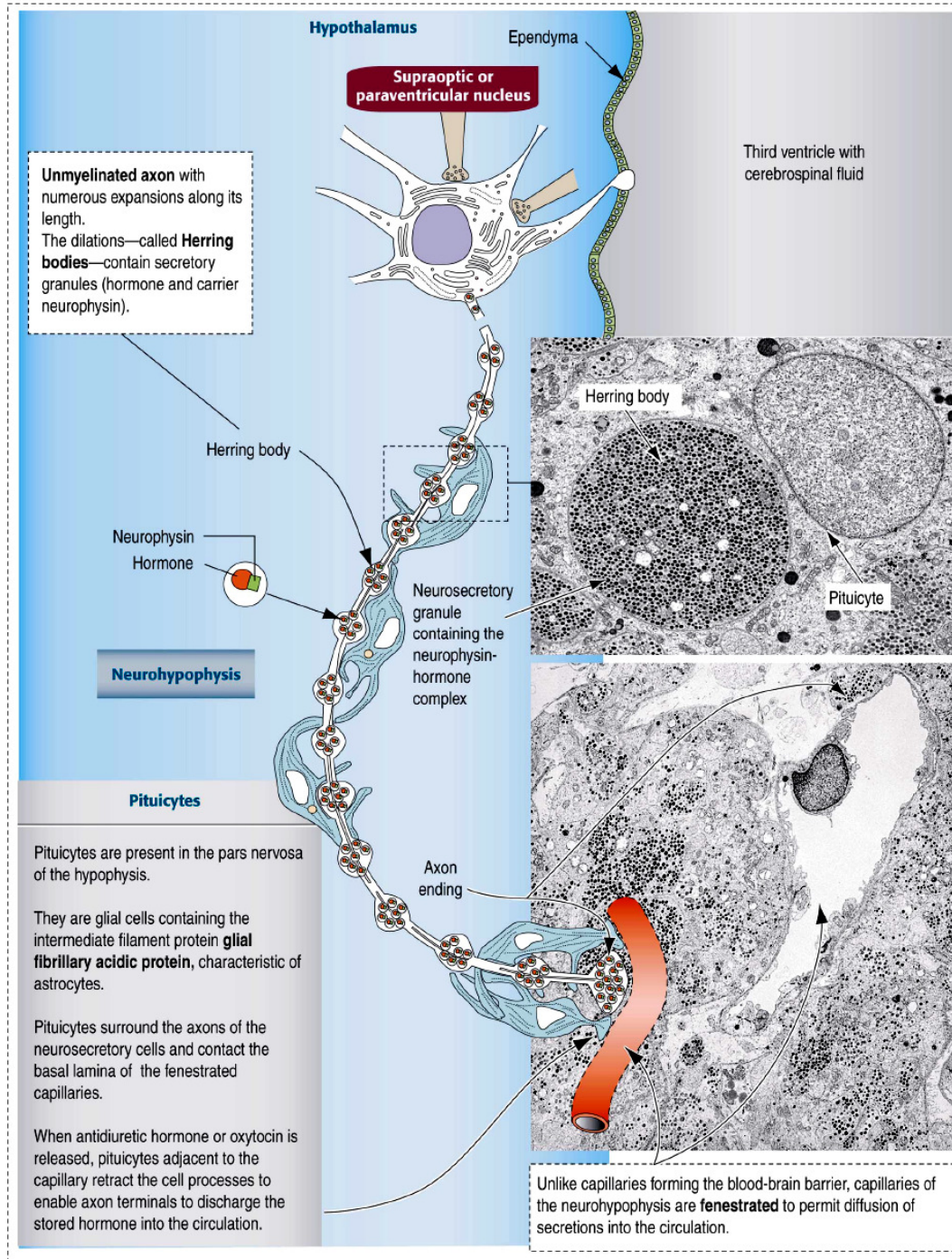
Neurohypophysis  
PAAB/PAS/Orange G

Herring bodies

pituicyte nuclei

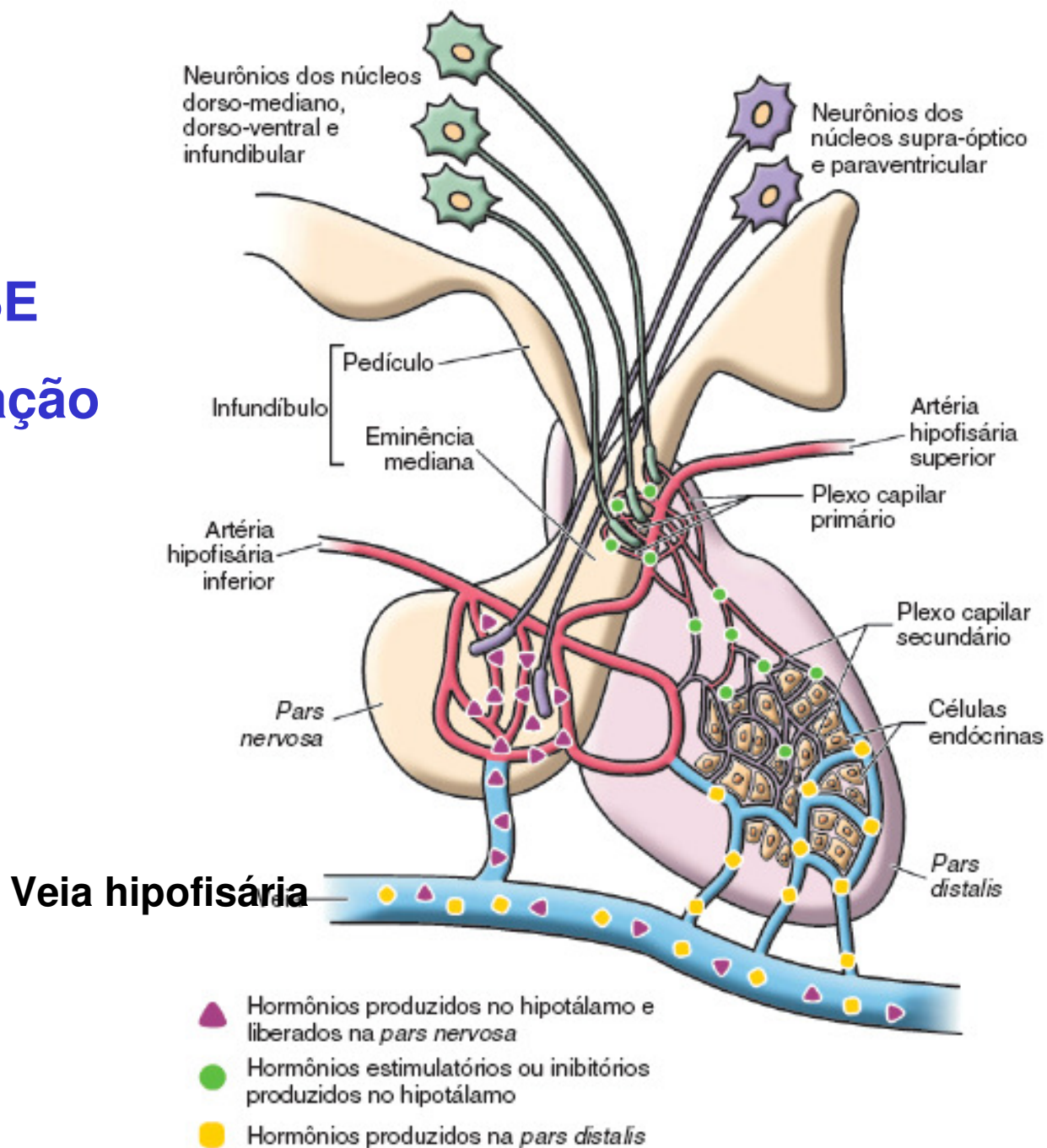


## Pars nervosa (hipófise posterior)

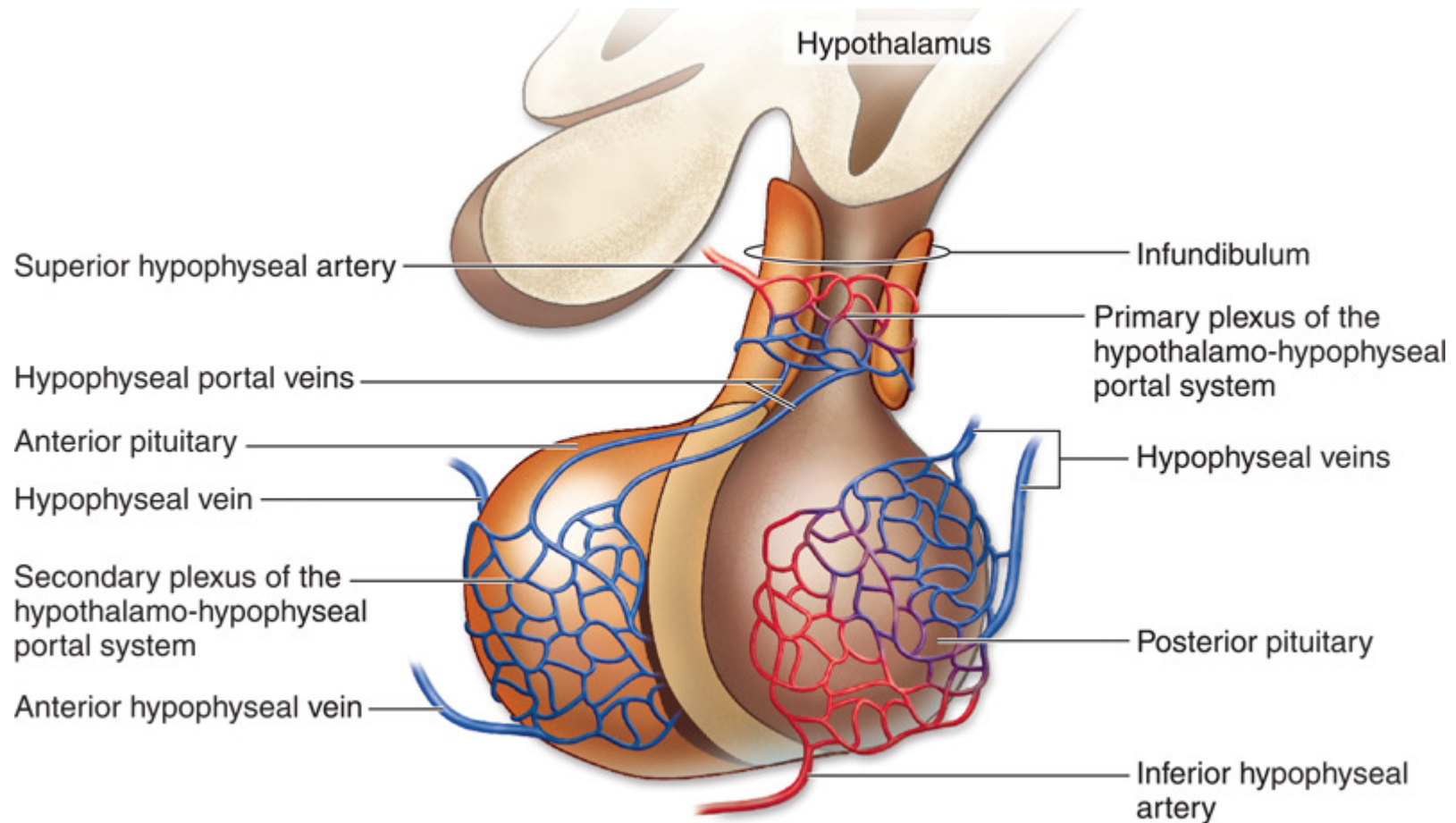


# HIPÓFISE

## Vascularização

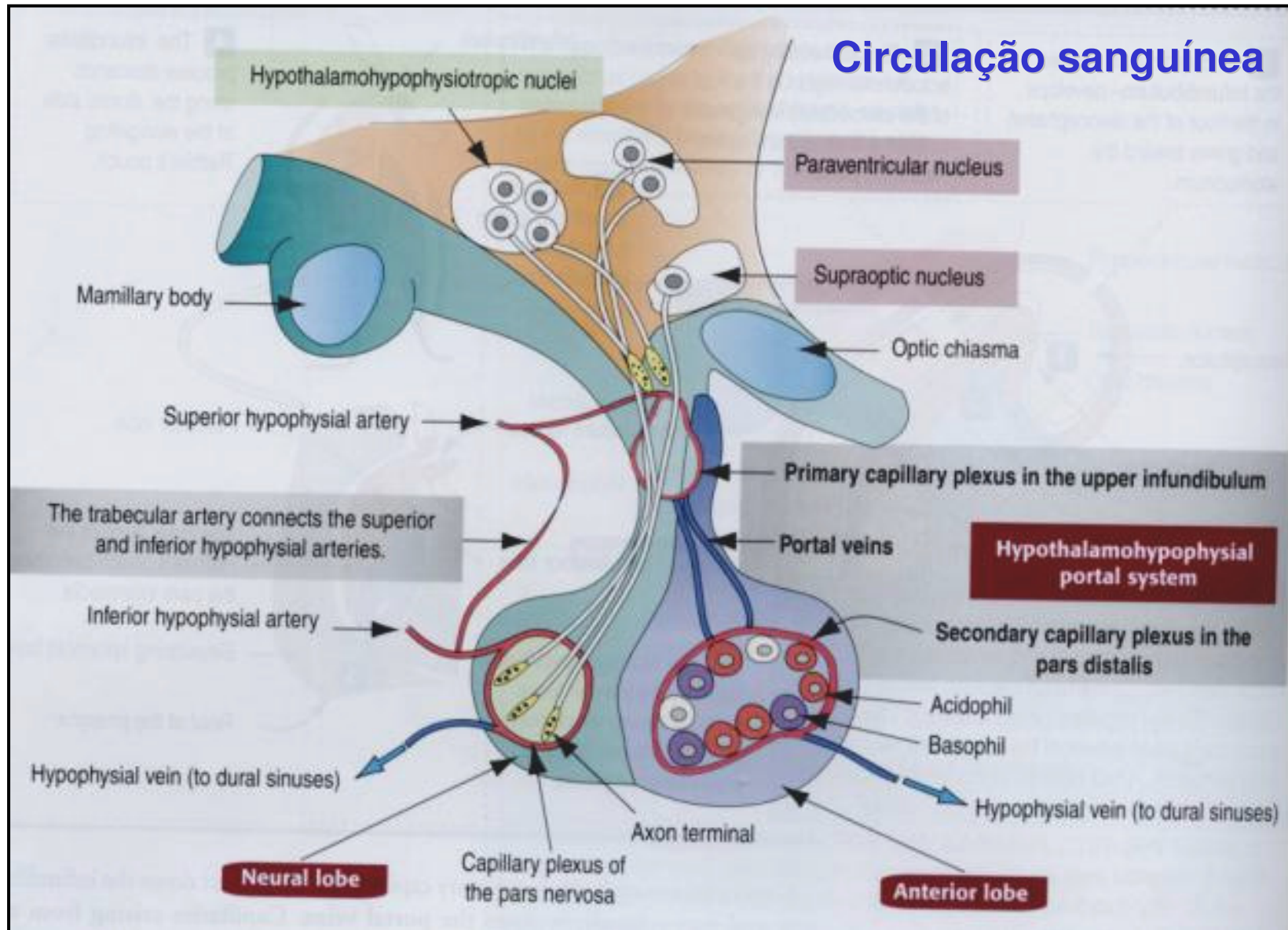


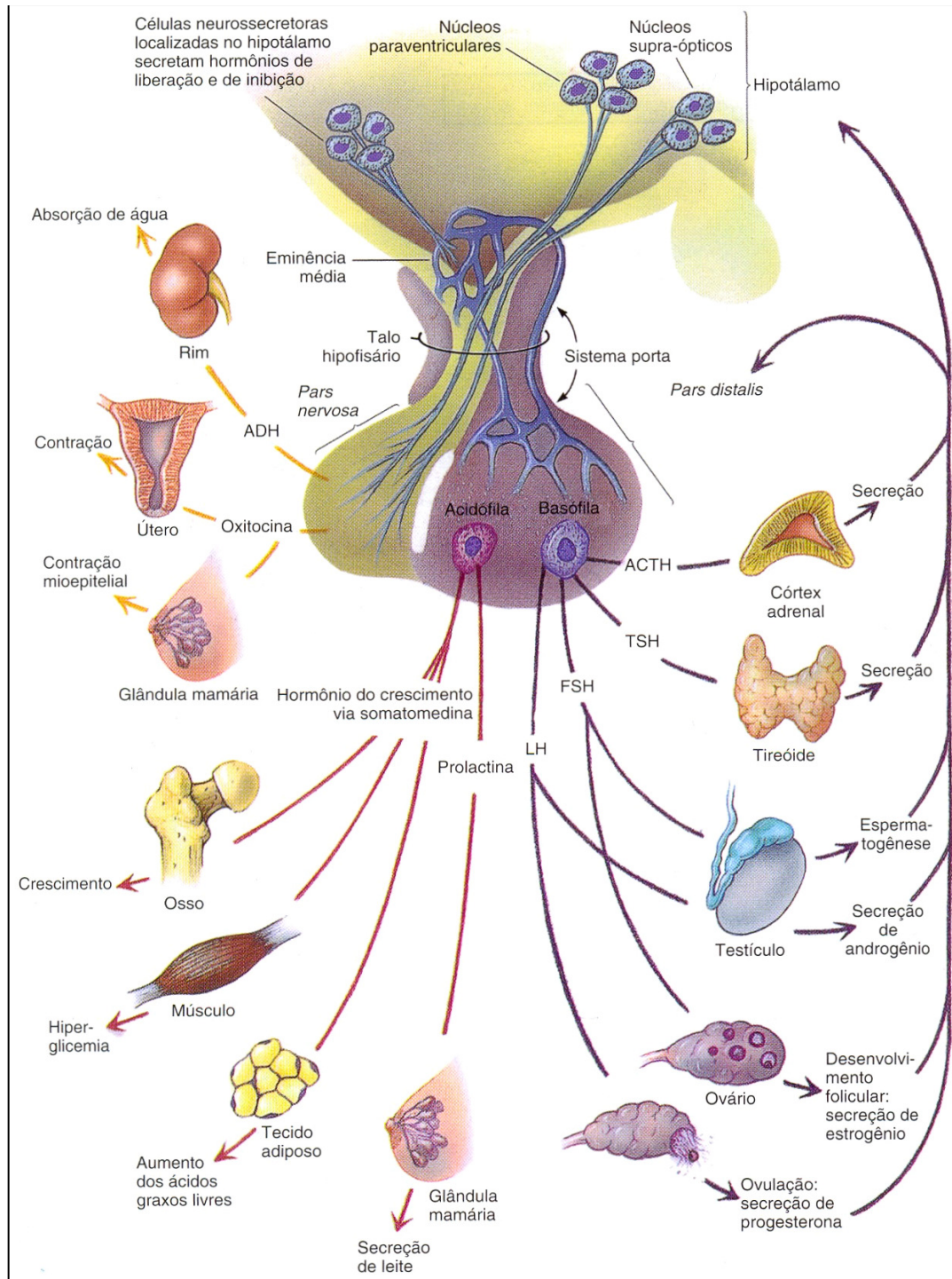
# HIPÓFISE :Vascularização



**(a) Hypothalamo-hypophyseal portal system**

# HIPÓFISE :Vascularização

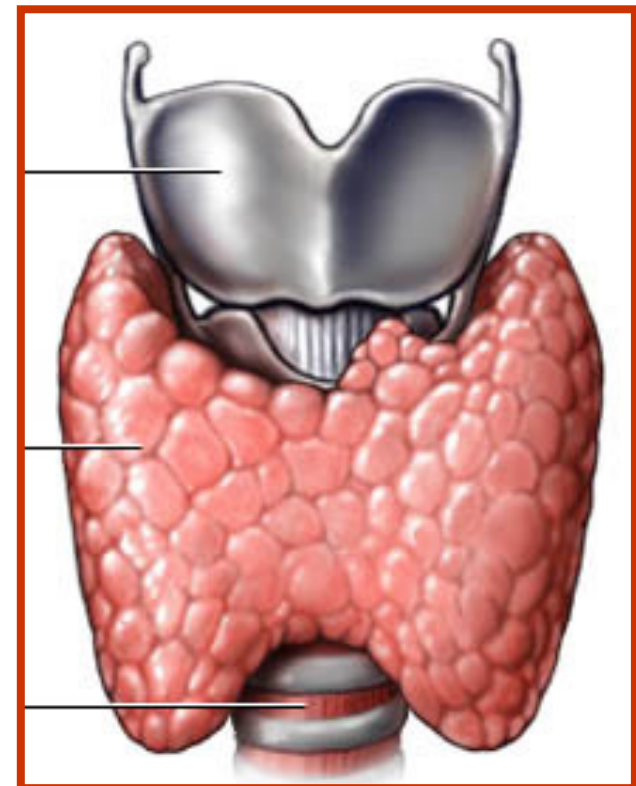
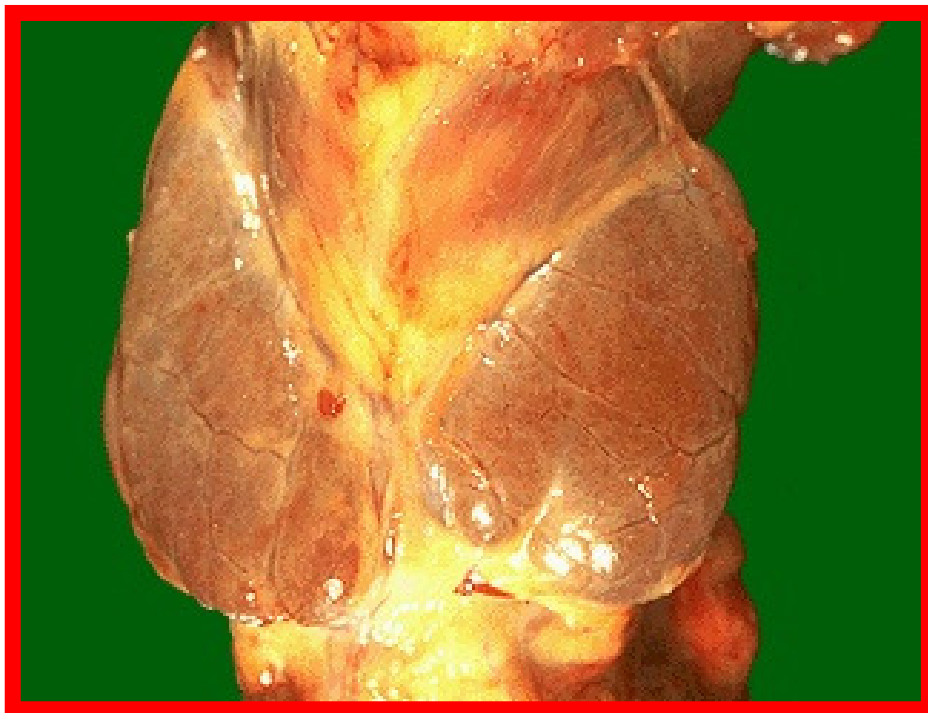




# Sistema Endócrino

## TIREÓIDE

- Dois lobos laterais unidos pelo istmo (lobo piramidal)
- Cápsula de TCD e trabéculas conjuntivas
- Folículos tireoidianos (colóide)  
células foliculares  
células parafoliculares (células C)

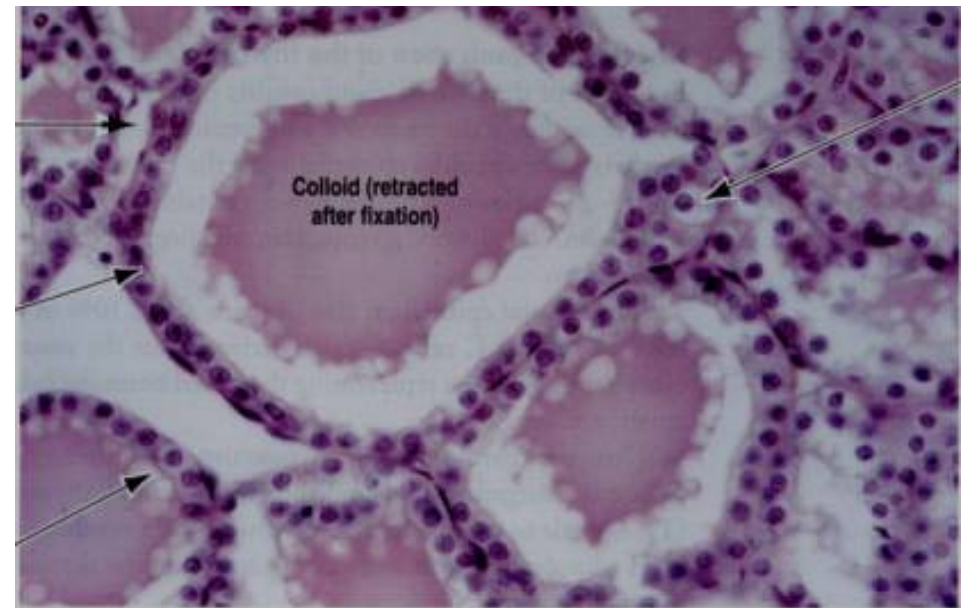
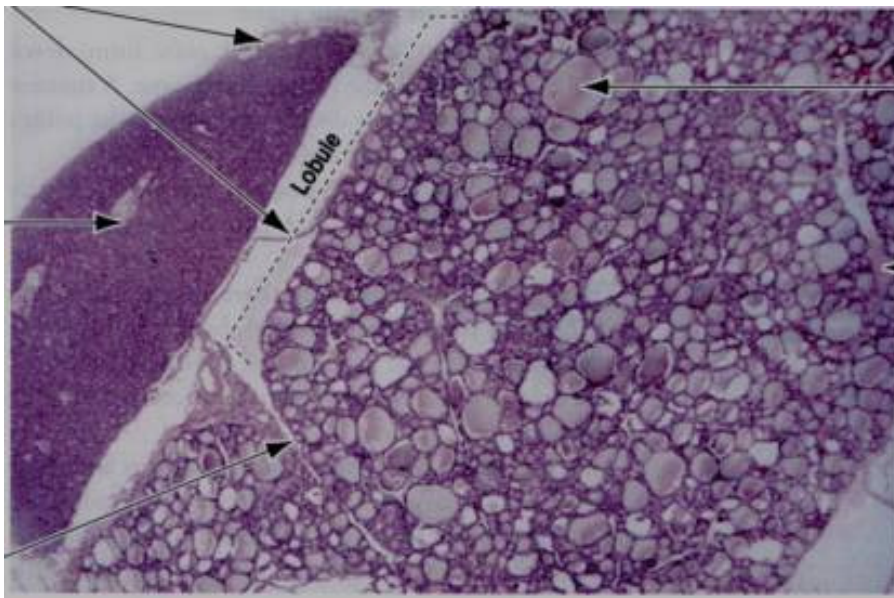


# Sistema Endócrino

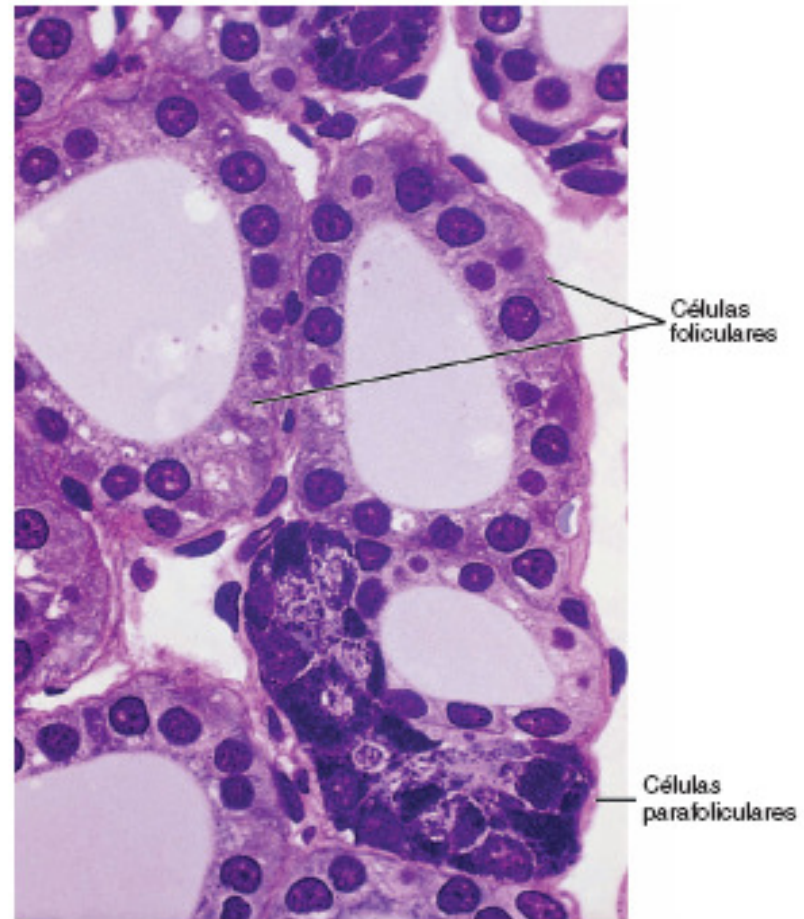
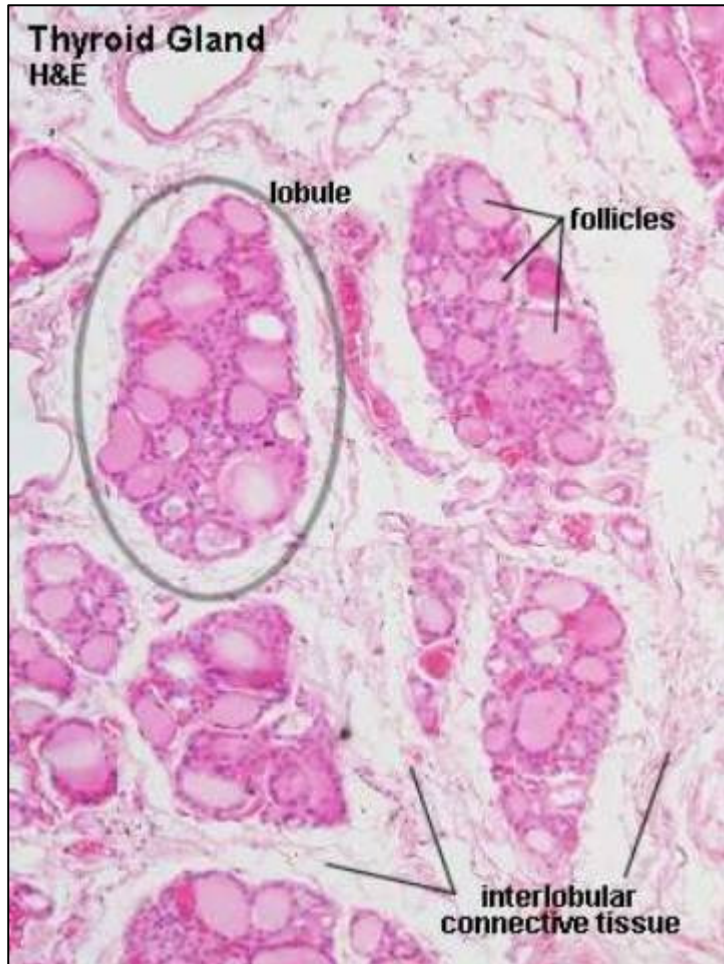
Tireóide : Glândula Endócrina Folicular

Folículos tireoidianos – Células Foliculares

Colóide - tireoglobulina (glicoproteína)



# Sistema Endócrino - Tireóide





# Sistema Endócrino - Tireóide

## Secreção dos hormônios tireoidianos – T3 e T4

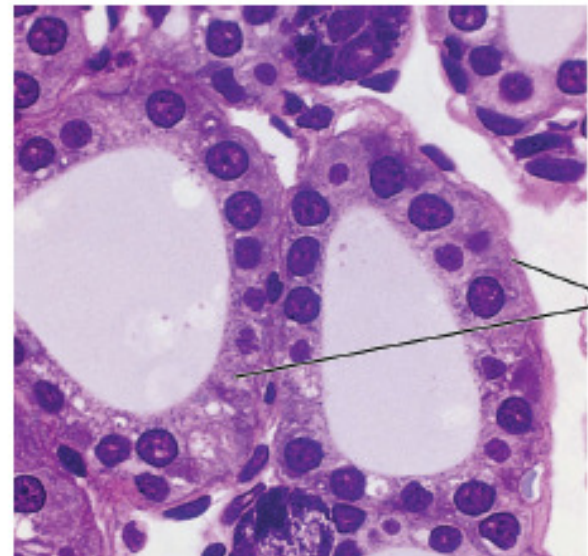
- A) Síntese da tireoglobulina.
- B) Seqüestro e transporte de iodeto.
- C) Ativação do Iodeto em iodo (enzima tireoperoxidase).
- D) Iodação dos radicais tirosina da tireoglobulina.
- E) Endocitose de partes do colóide
- F) Fusão das vesículas com lisossomos e formação de T3 e T4, MIT, DIT.

MIT – Monoiodotirosina

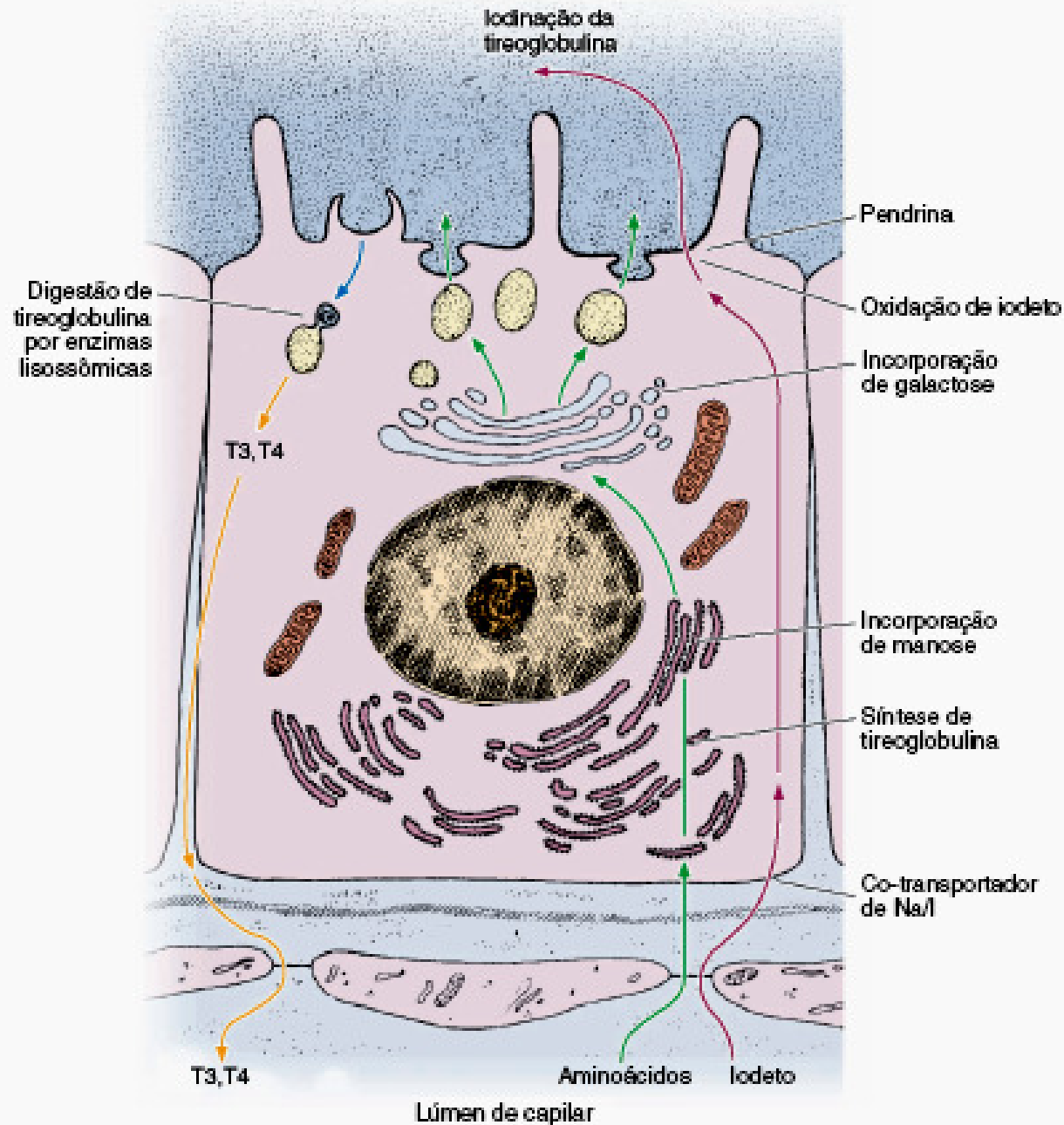
DIT – Diiodotirosina

T3 – Triiodotirosina

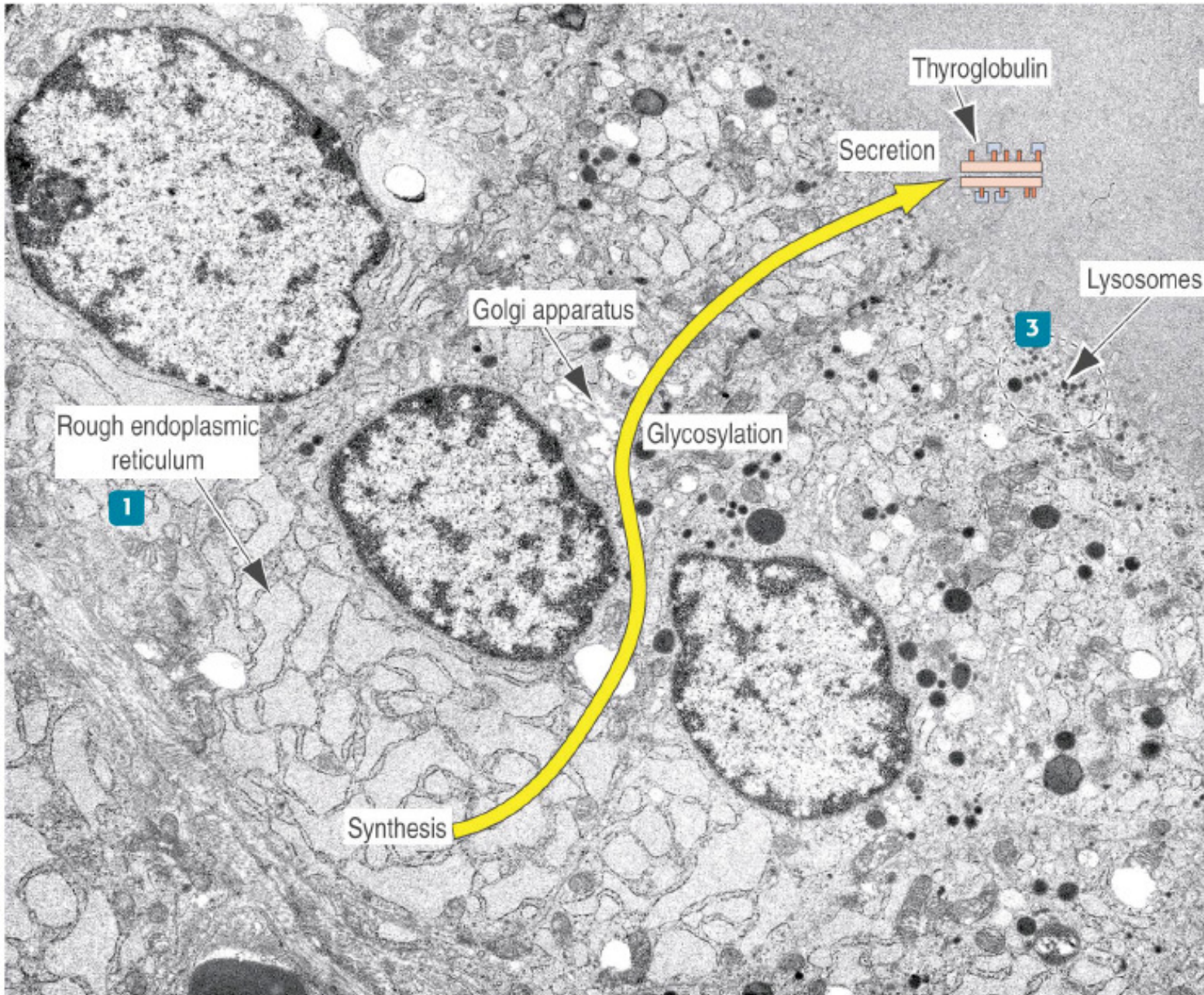
T4 - Tetraiodotirosina



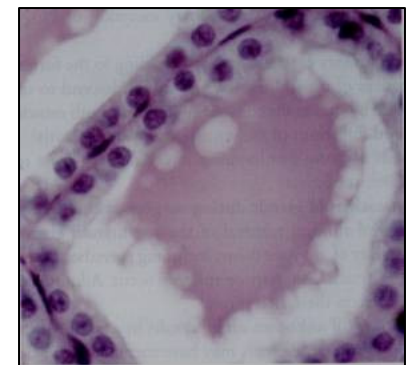
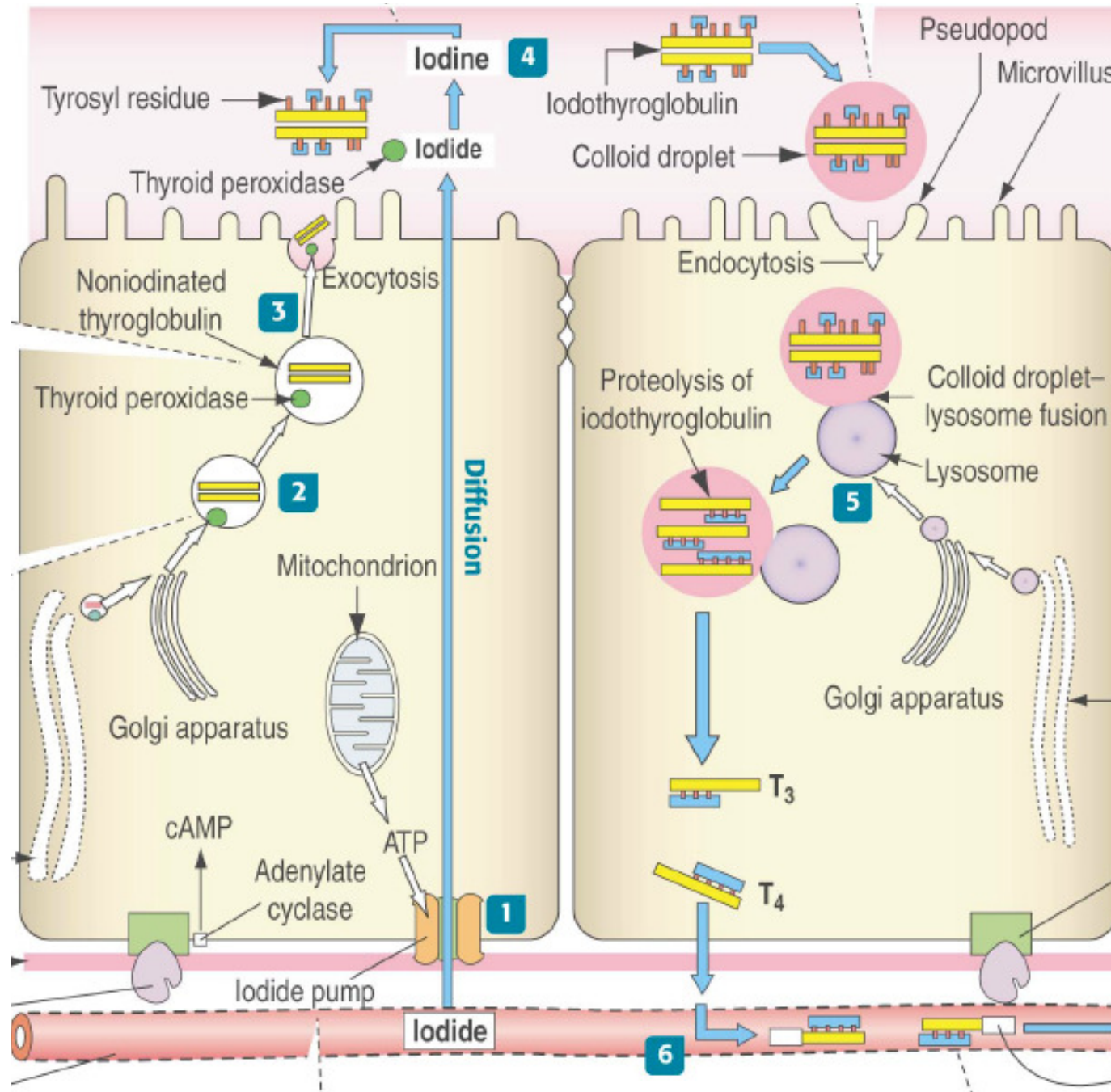
# Sistema Endócrino - Tireóide



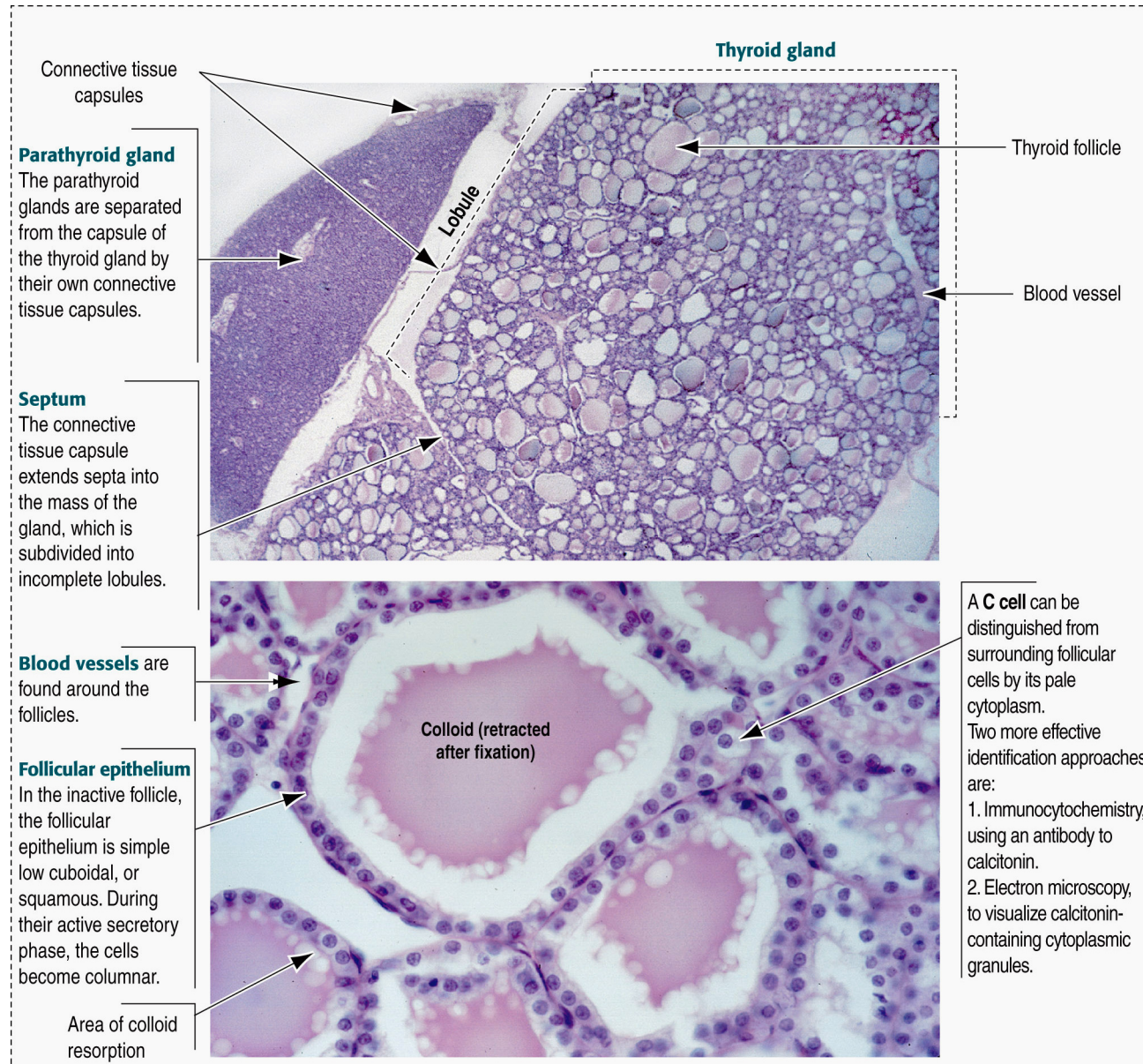
# Sistema Endócrino - Tireóide



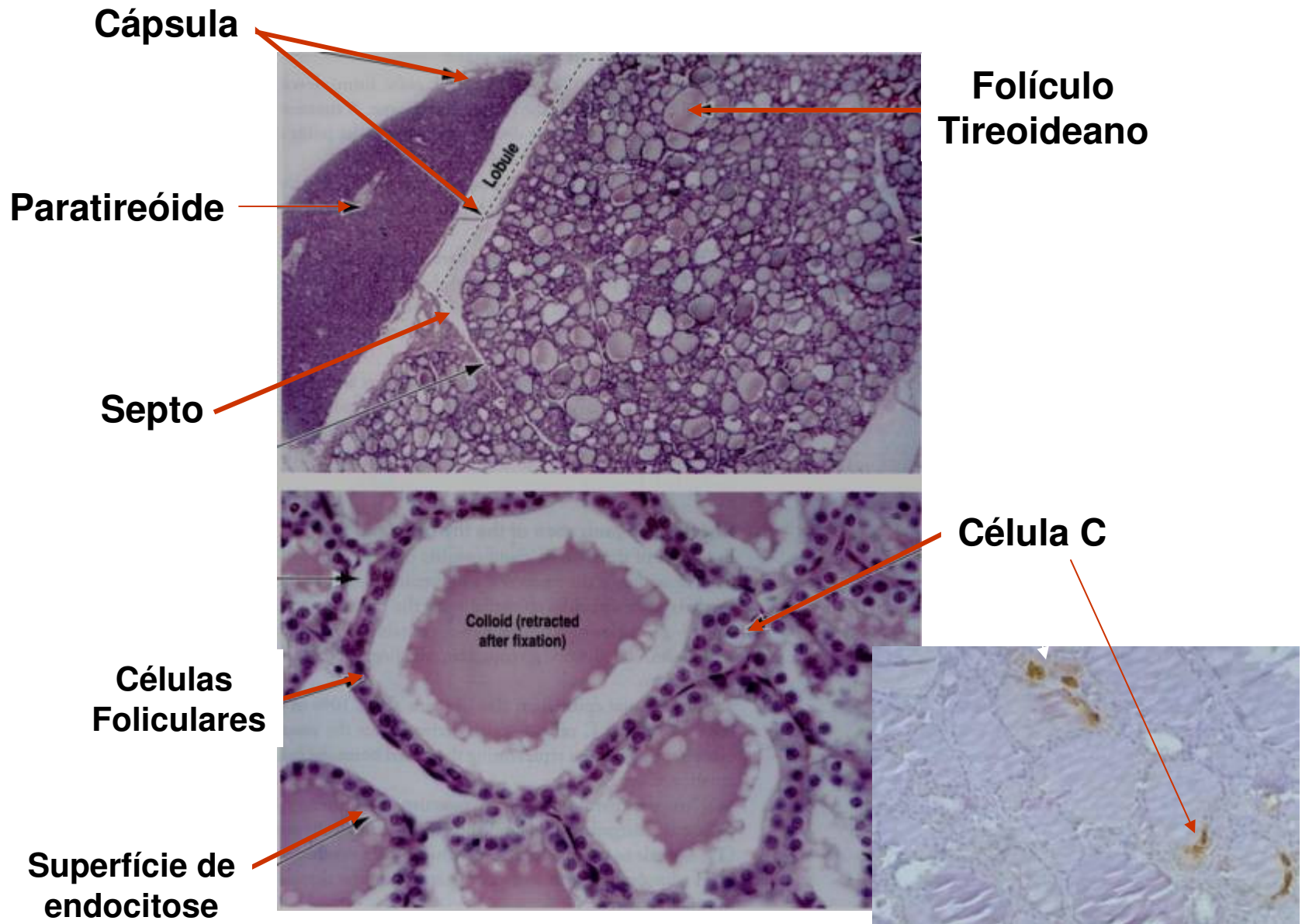
# Tireóide



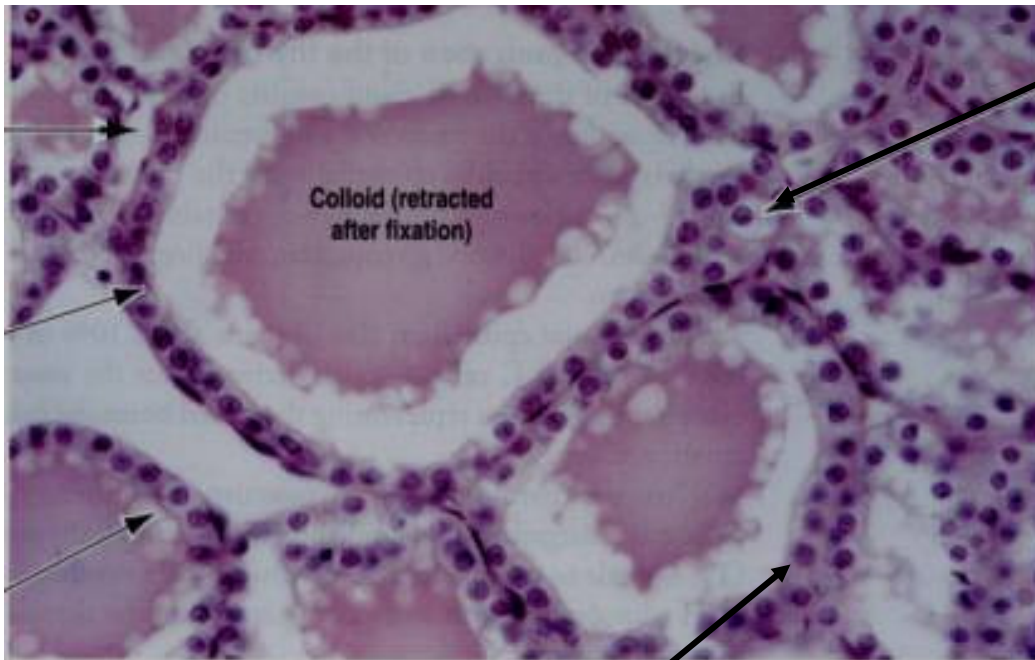
# Sistema Endócrino - Tireóide



# Sistema Endócrino - Tireóide

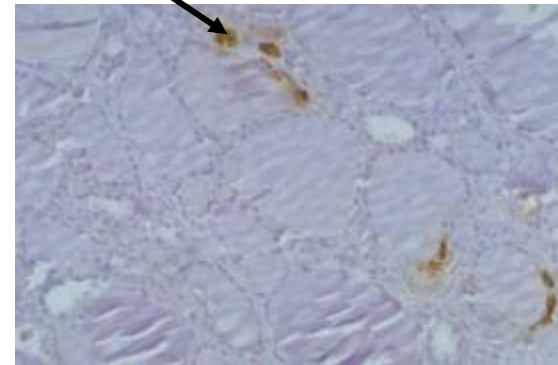


# Sistema Endócrino - Tireóide



Células Foliculares

Célula C (Parafoliculares)

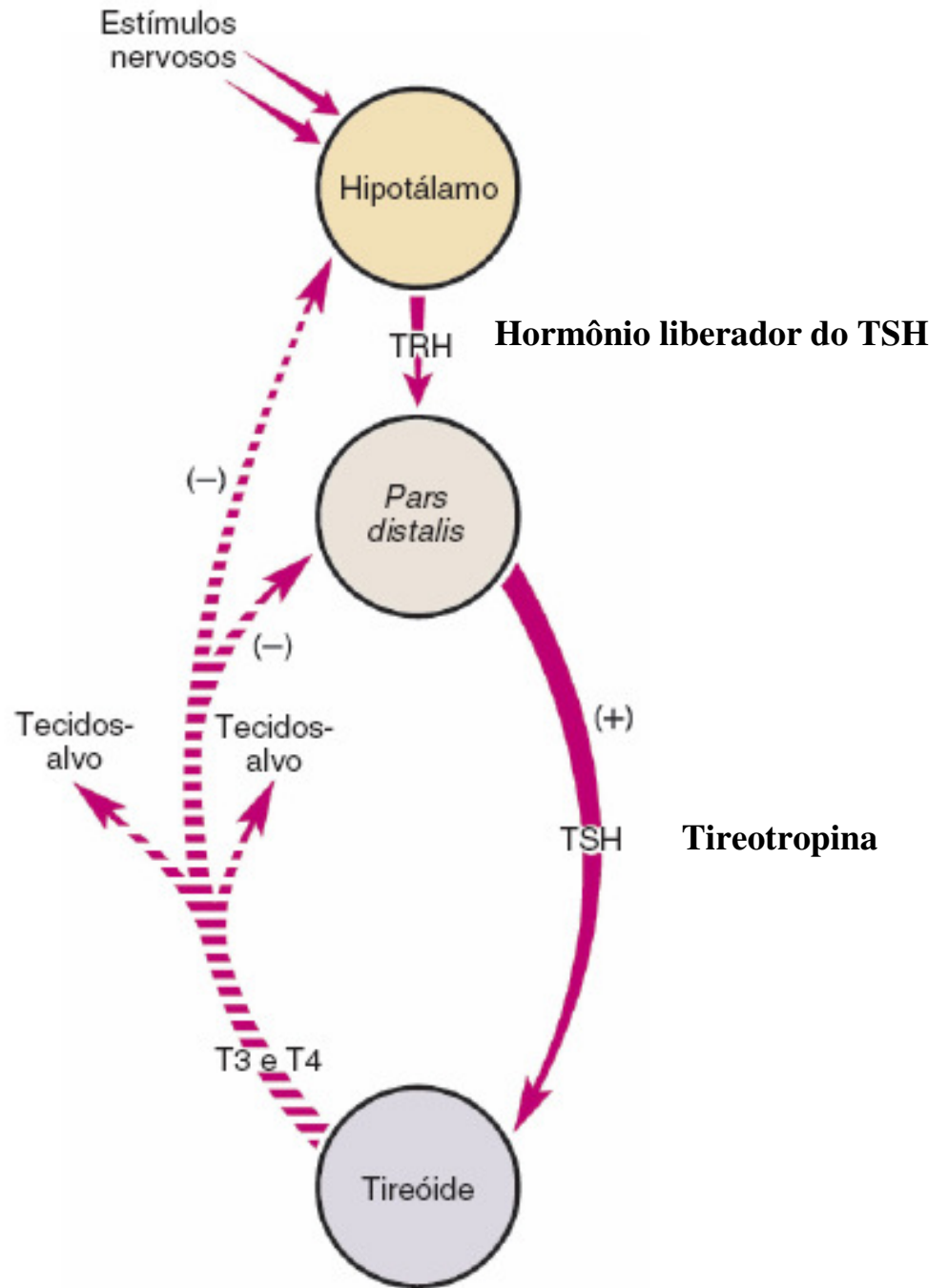


Secreção de calcitonina

Inibe a reabsorção óssea  
Diminui Cálcio no sangue

# Sistema Endócrino Tireóide

## Controle hormonal





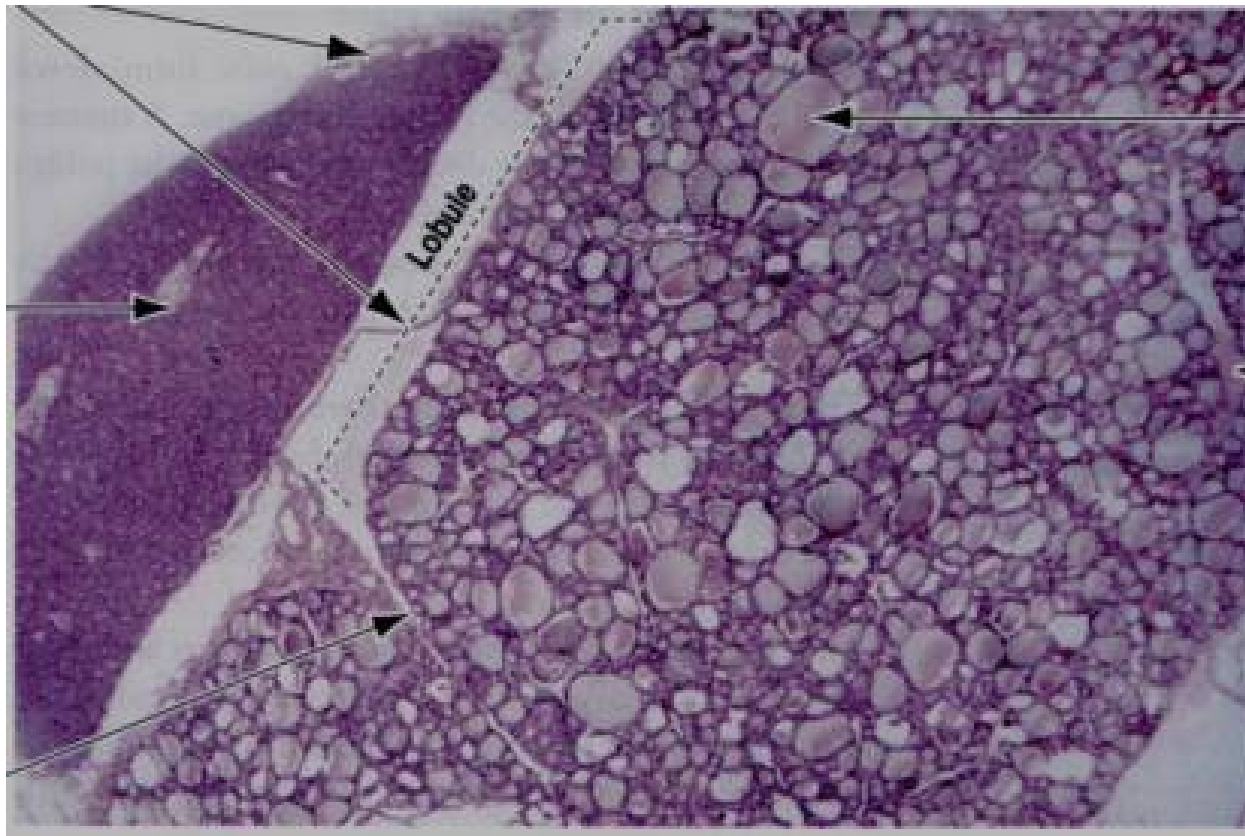
# Sistema Endócrino: Paratireóide

Dois pares (superiores e inferiores)

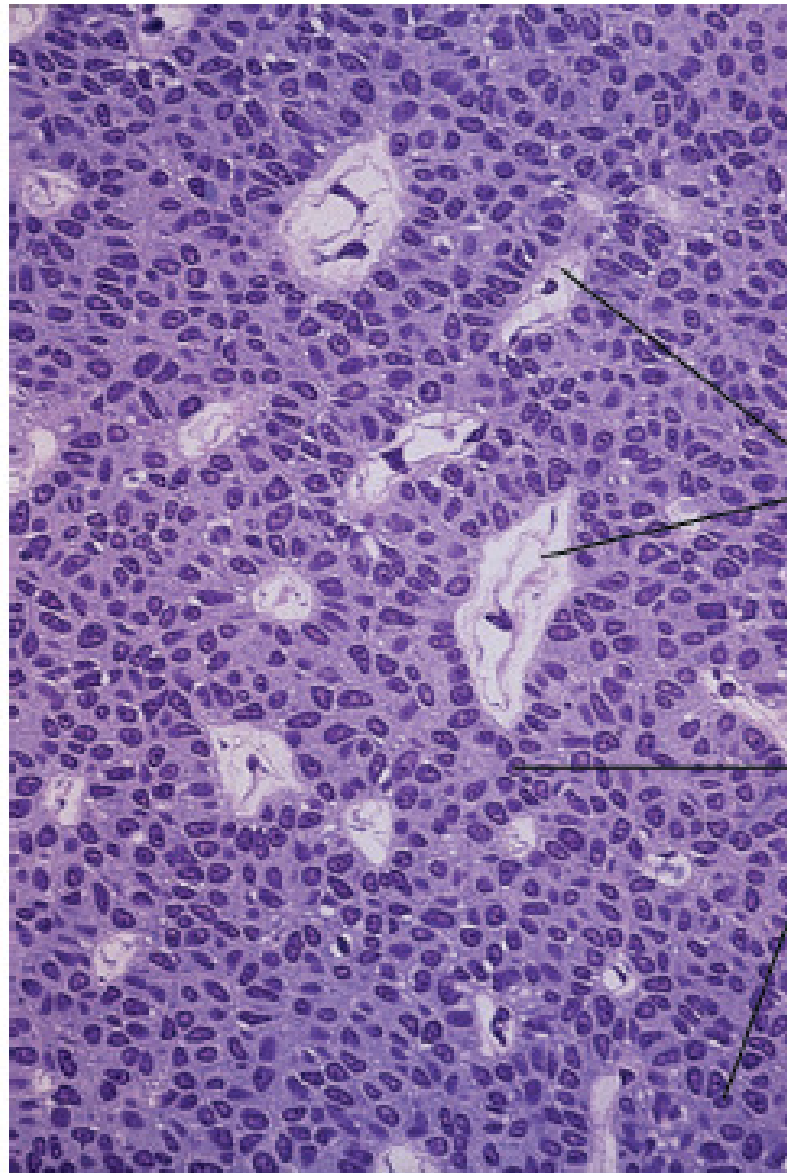
Fina cápsula de TCD e trabéculas

Tipos celulares – células principais (PTH) e células oxífilas ?

- Células principais - PTH (paratormônio) - mobilizam o  $\text{Ca}^{+2}$  do OSO



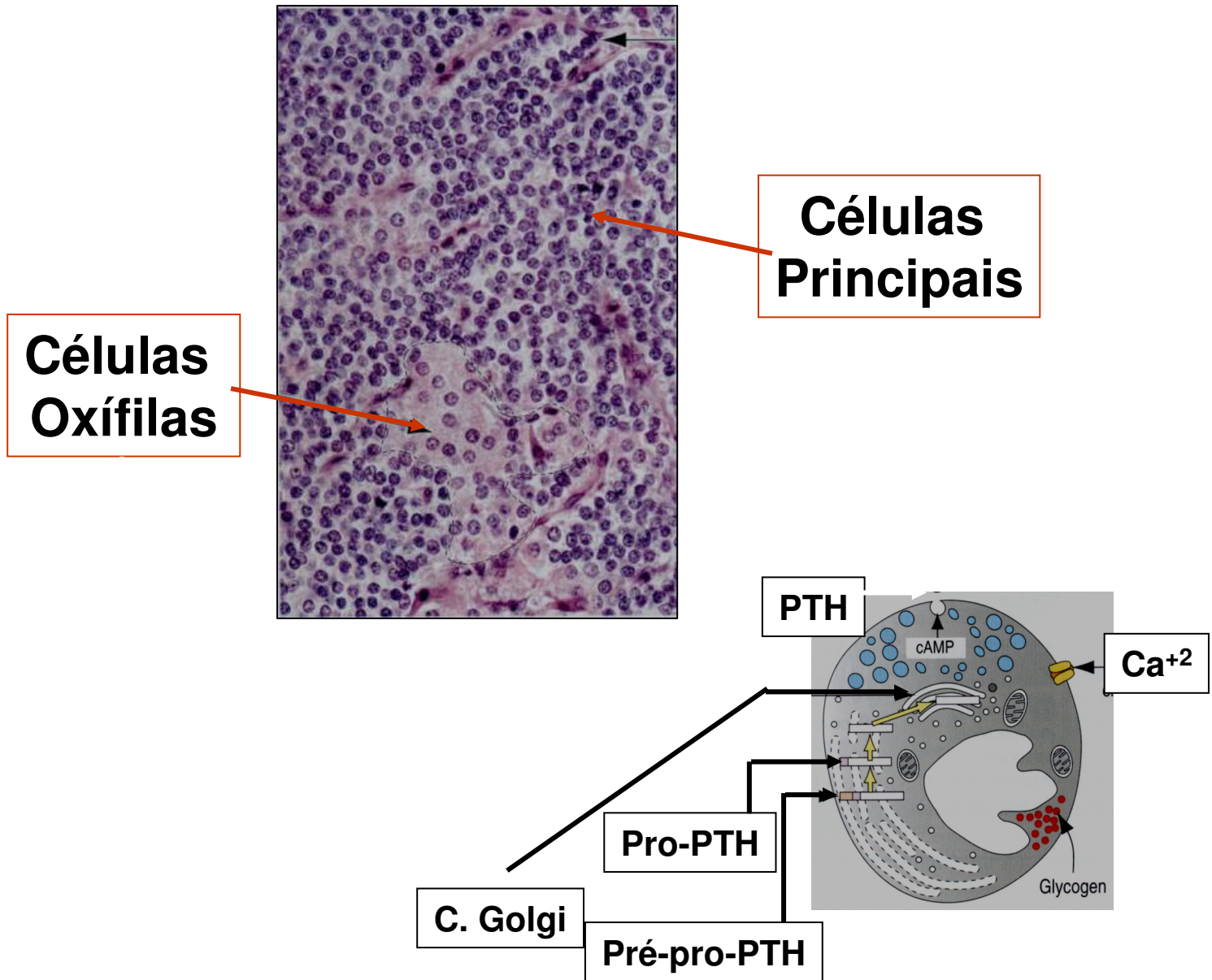
# Sistema Endócrino: Paratireóide



Capilares  
sanguíneos

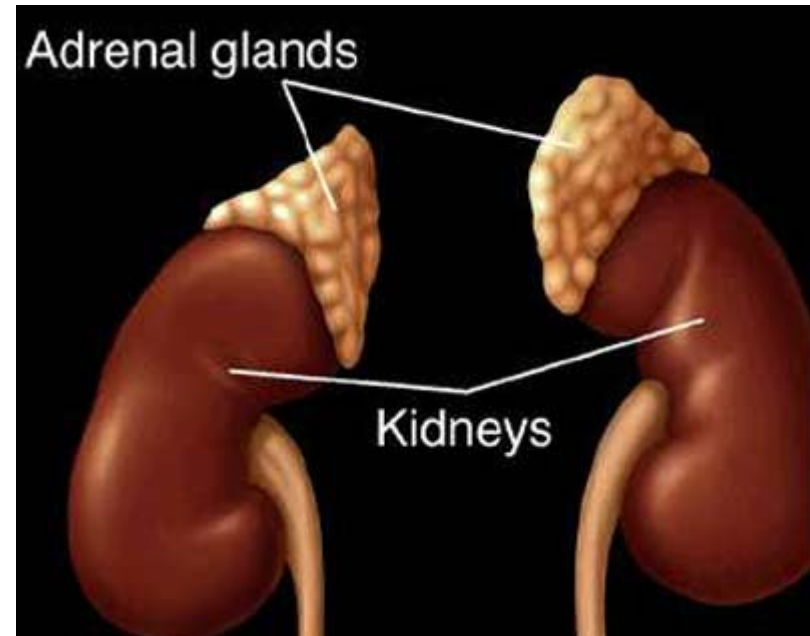
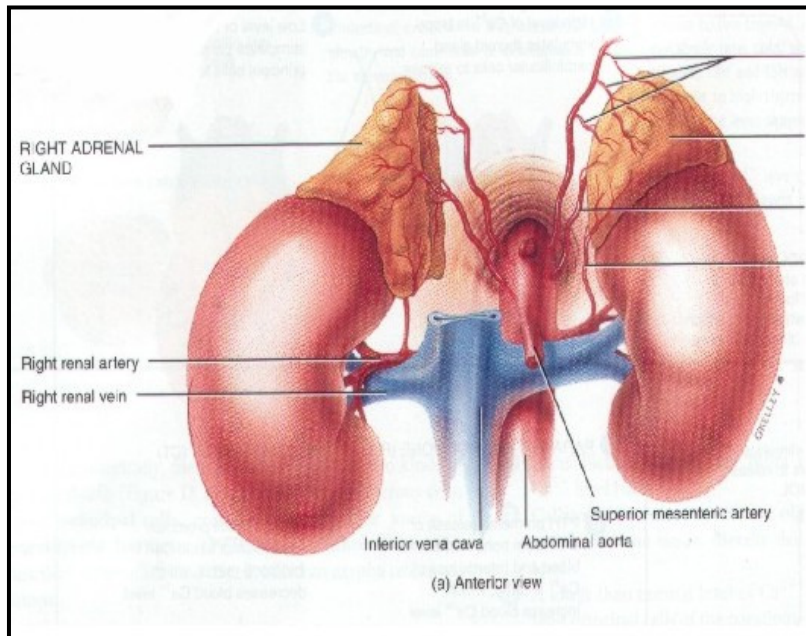
Cordões  
celulares

# Sistema Endócrino: Paratireóide



# Sistema Endócrino - Adrenal

Pares e sobre o pólo superior dos rins  
(tec.adiposo peri-renal)



# Sistema Endócrino - Adrenal

Fina cápsula de TCD e trabéculas

## Córtex (mesoderma)

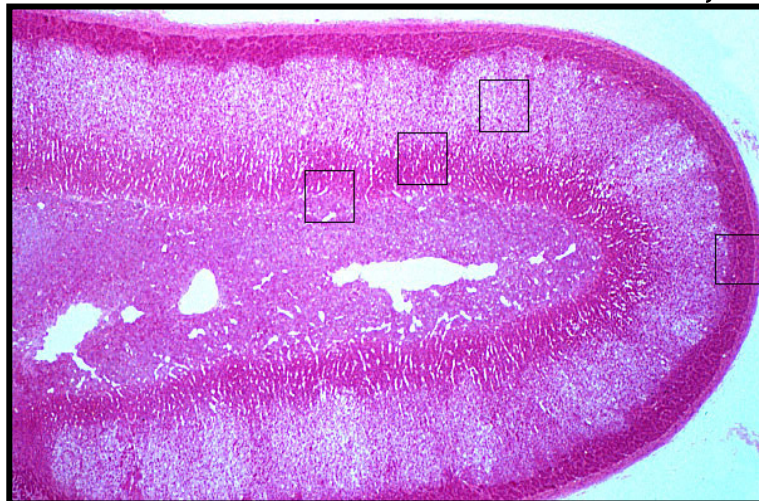
Zona glomerulosa – mineralocorticóides (aldosterona)

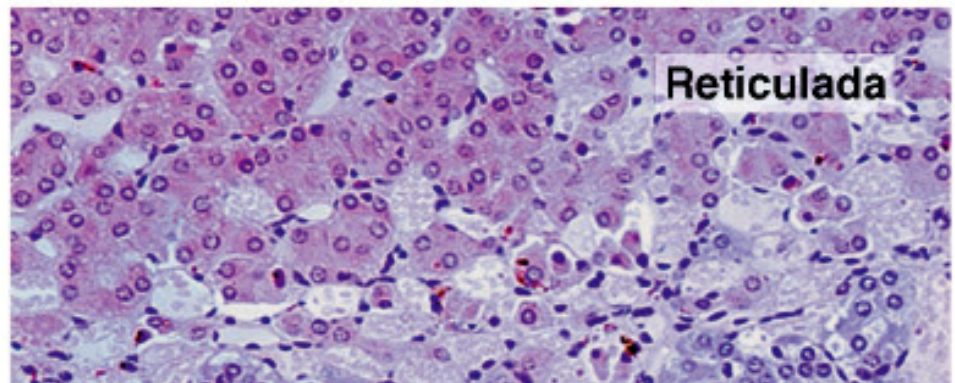
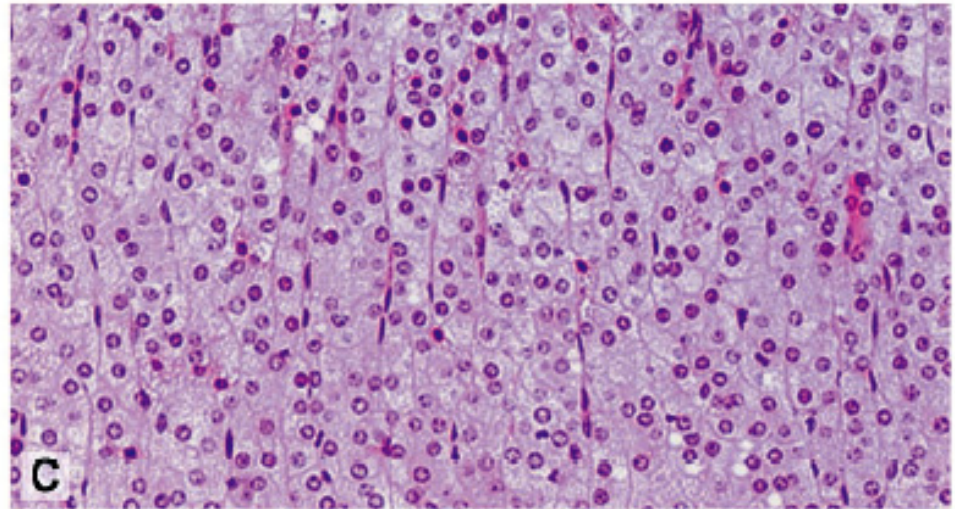
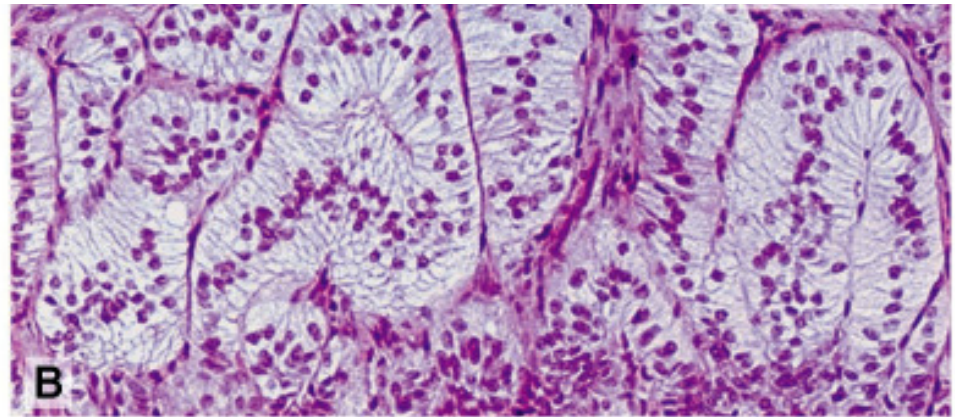
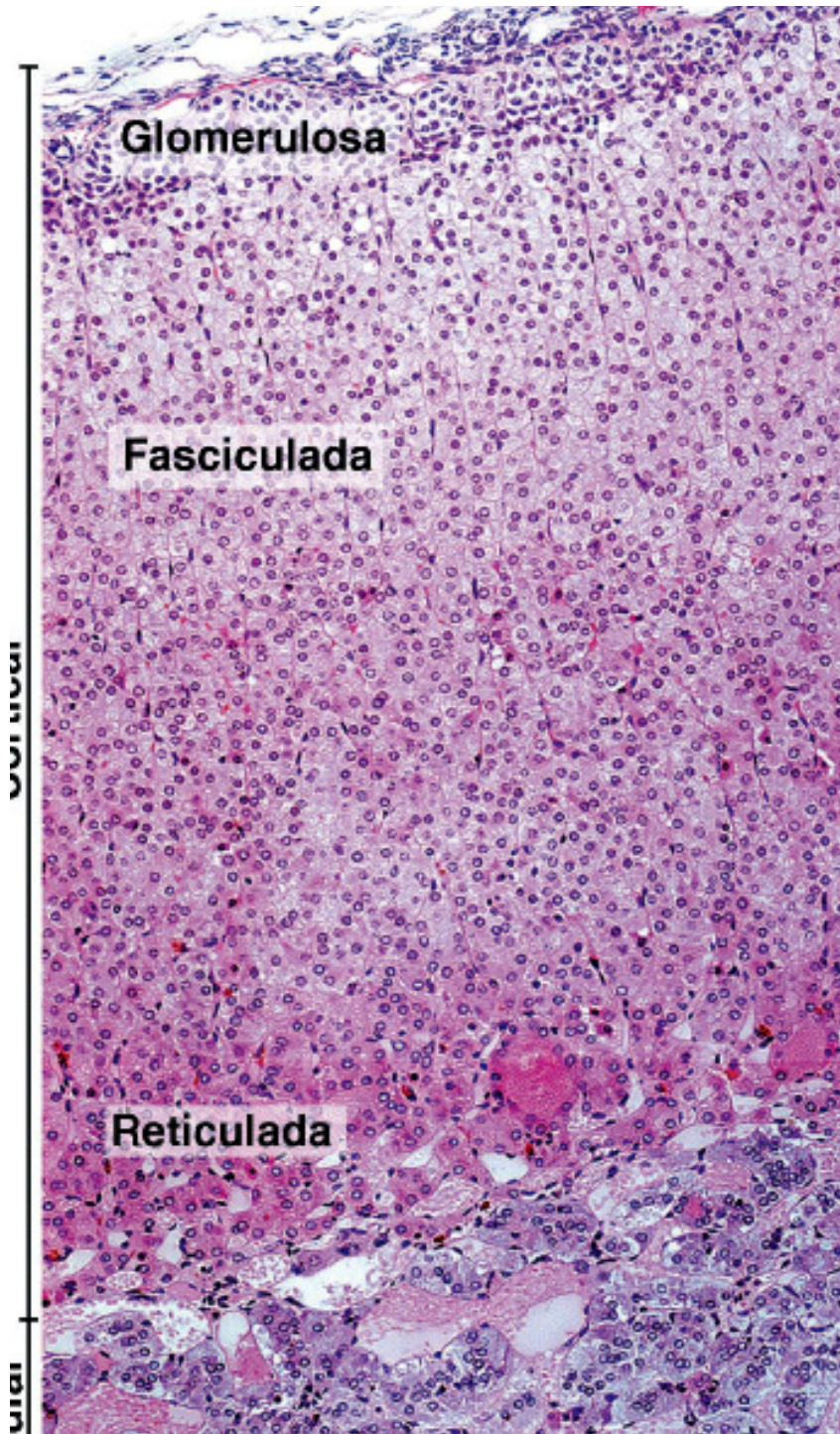
Zona fasciculada - glicocorticóides e andrógenos (ACTH)

Zona reticulada – andrógenos

## Medula (crista neural)

células cromóafins-catecolaminas: adrenalina, noradrenalina,





# Sistema Endócrino

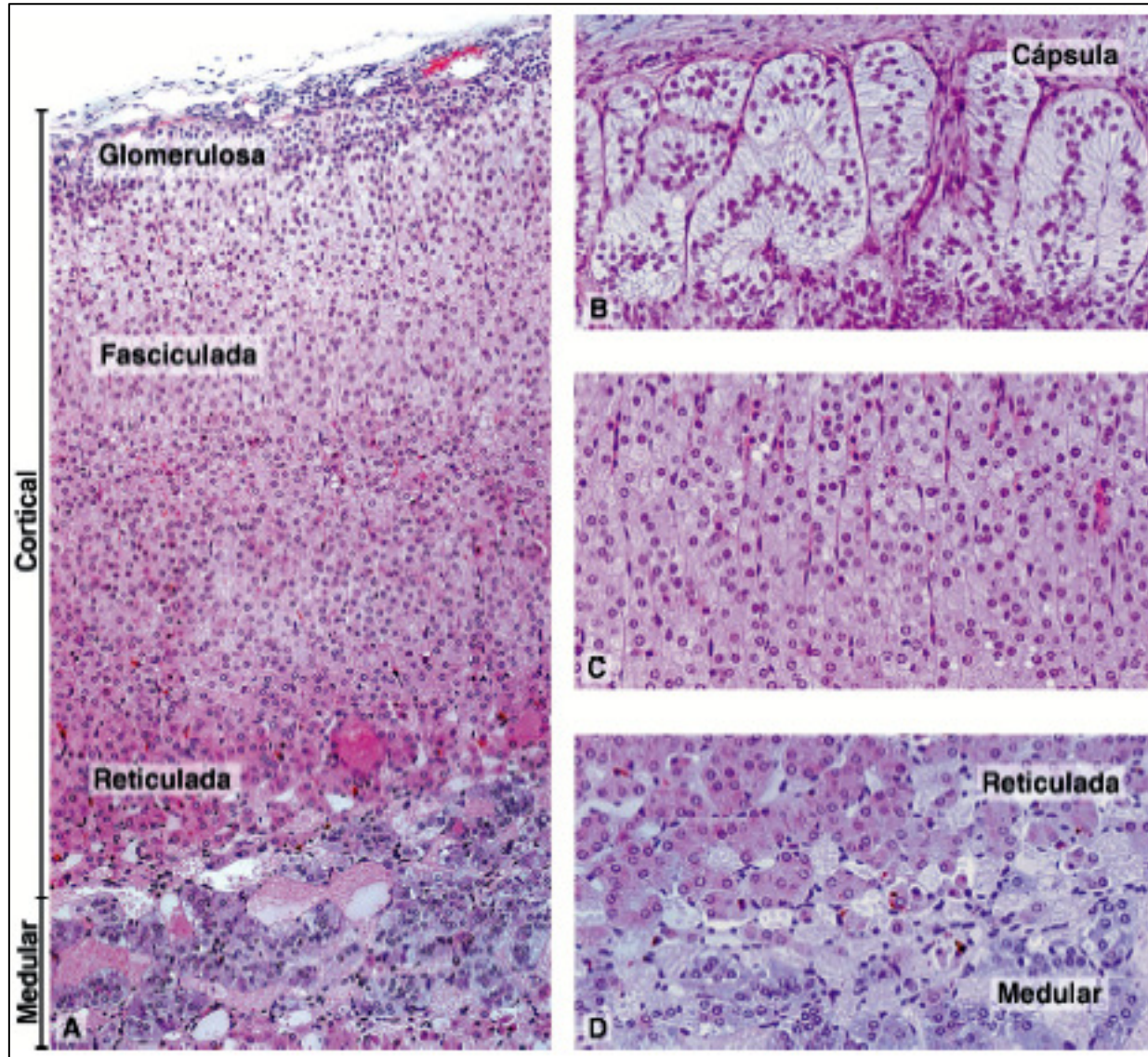
## CÓRTEX

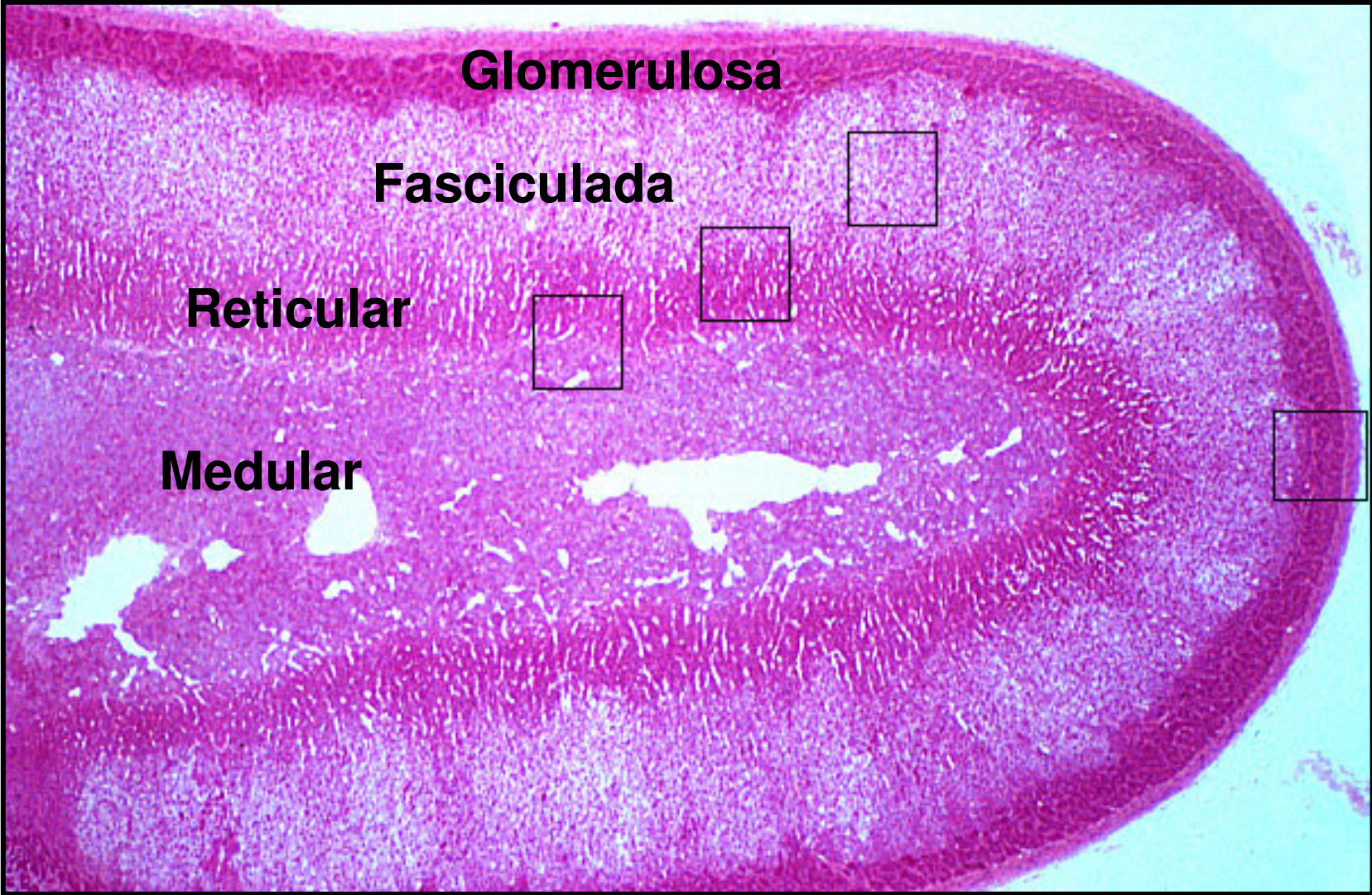
**Zona glomerulosa** – células colunares ou piramidais organizadas em cordões -arcos

**Zona fasciculada** – células poliédricas organizadas em cordões retos e regulares  
**espongiócitos**

**Zona reticulada** – células organizadas em cordões irregulares

## MEDULA





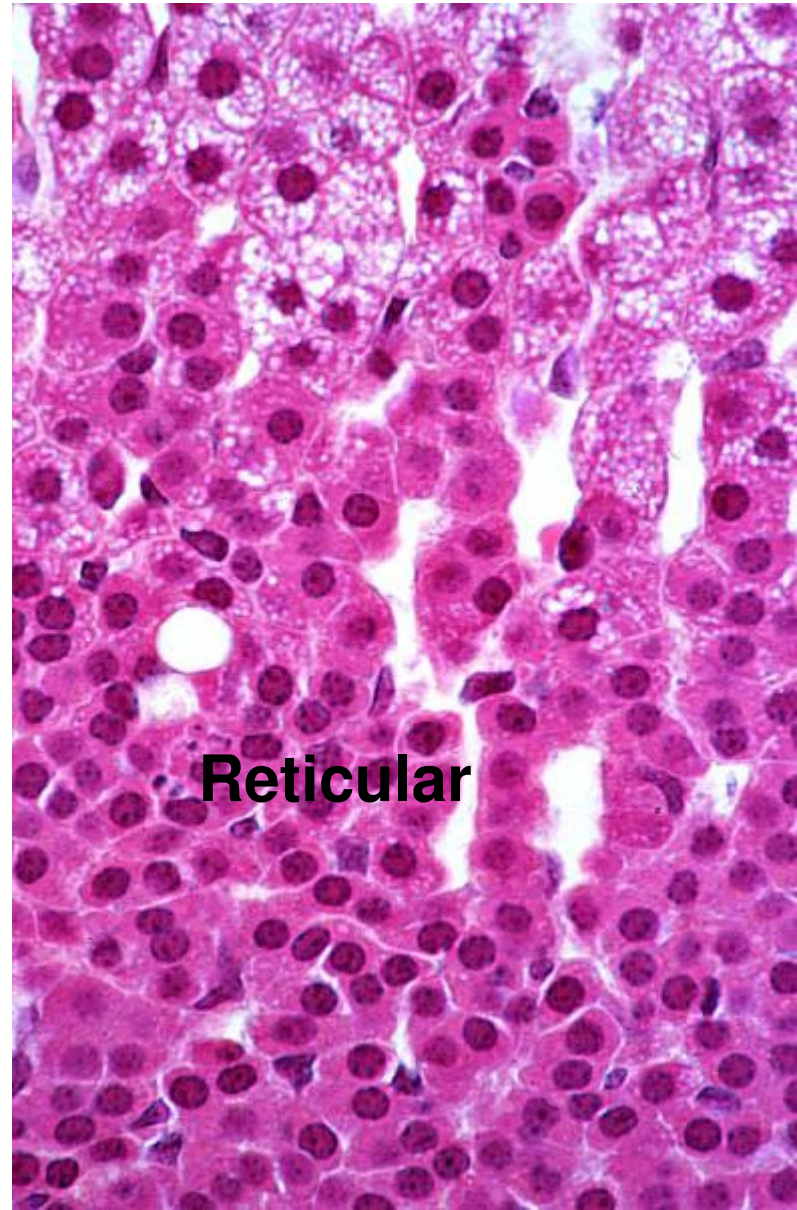
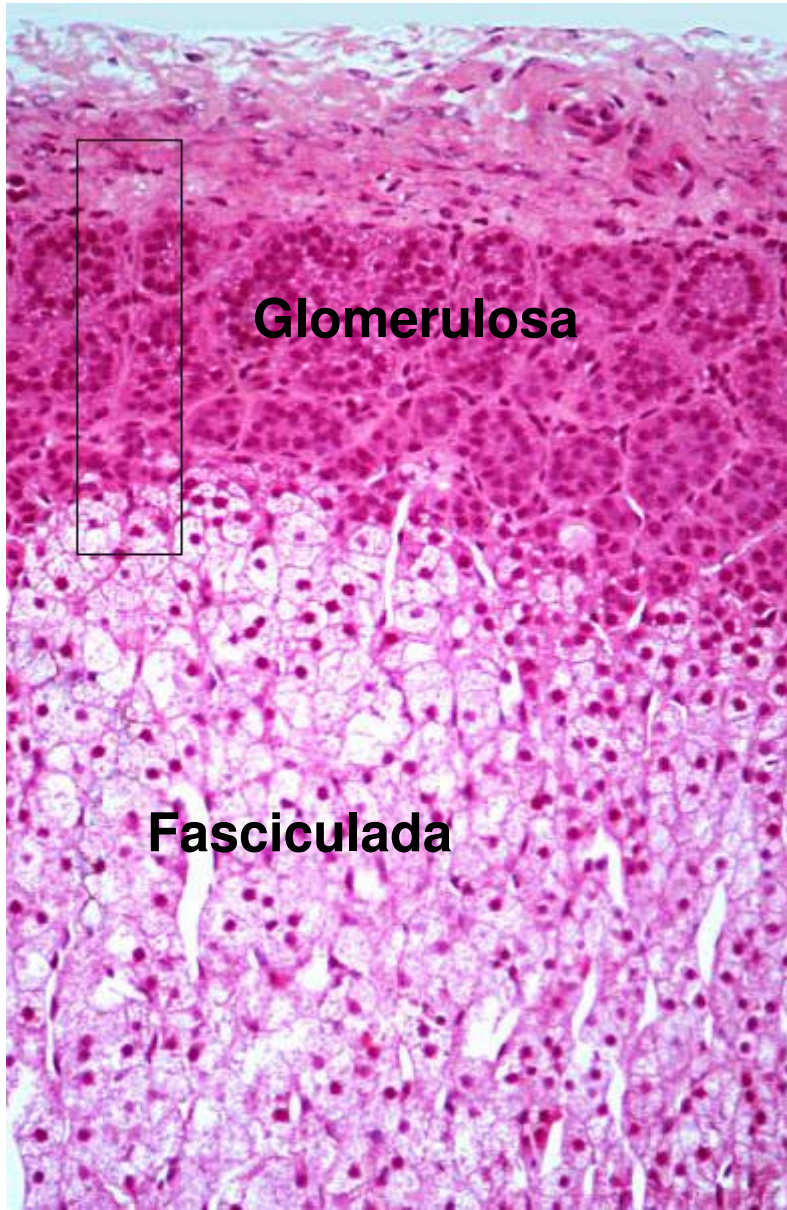
**Glomerulosa**

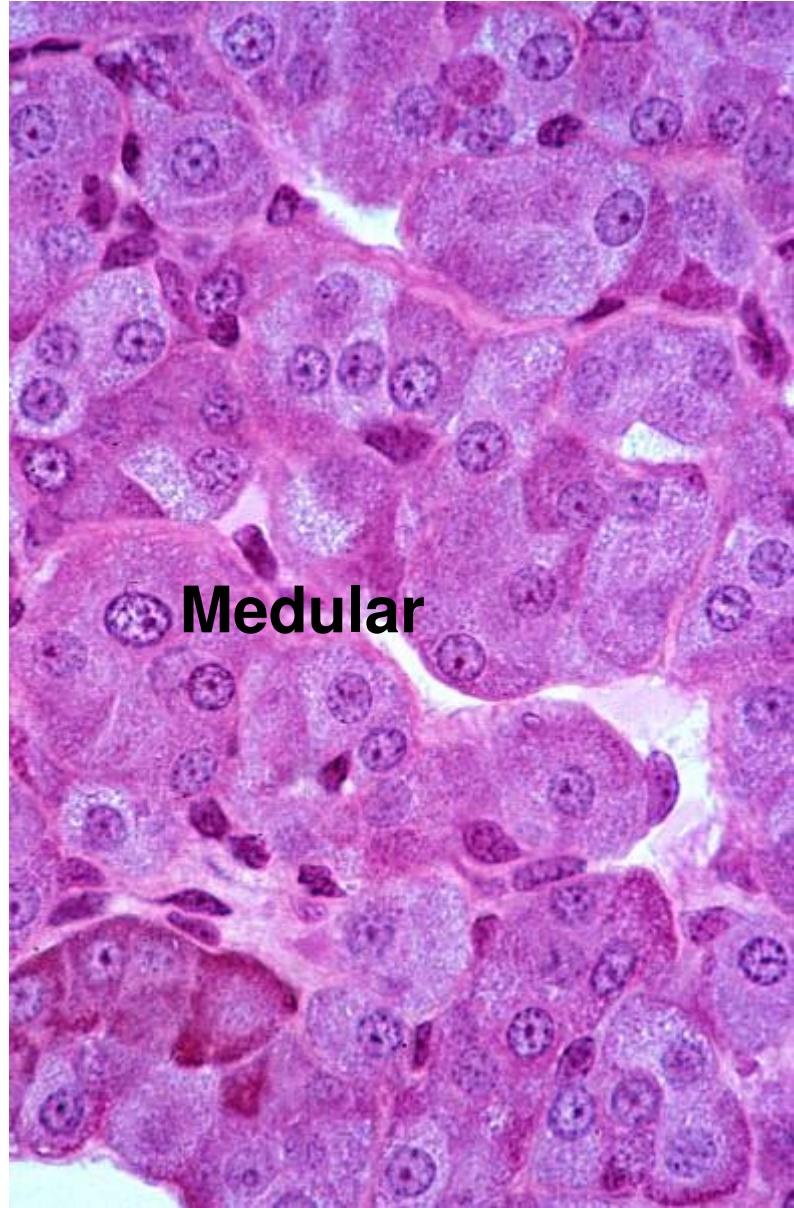
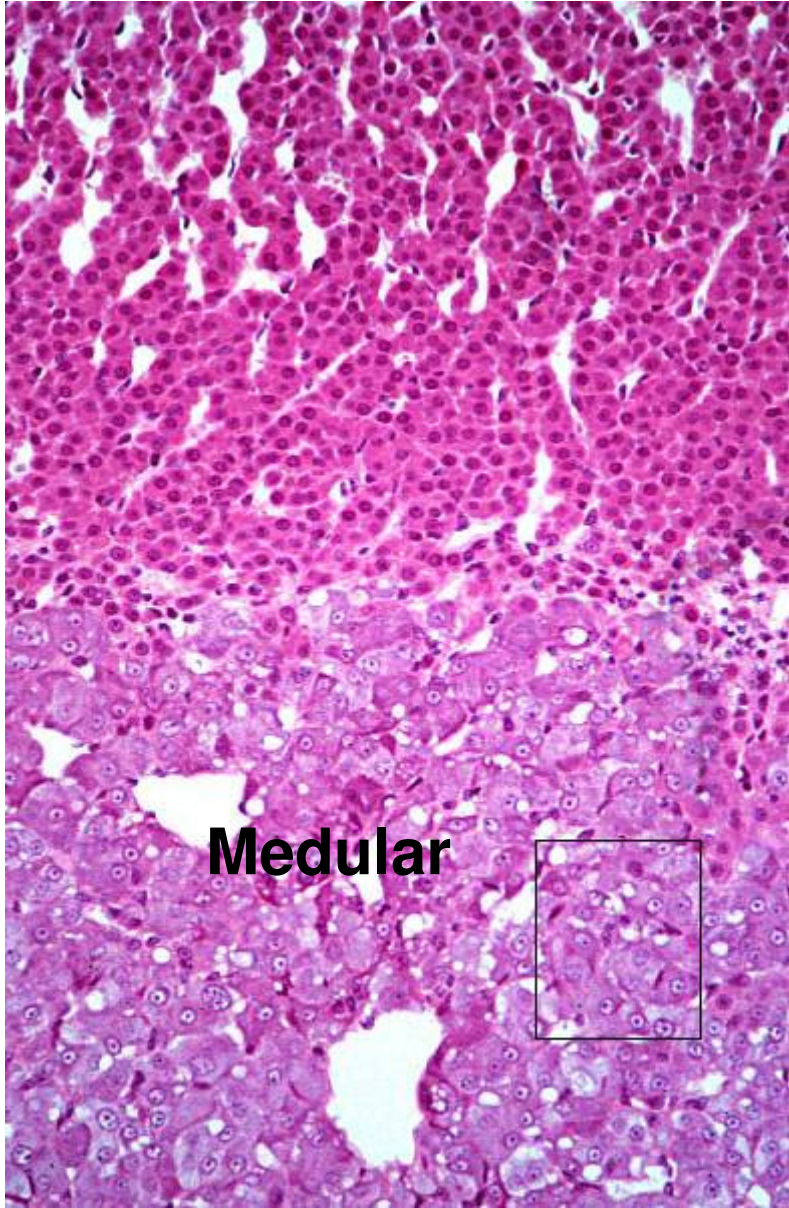
**Fasciculata**

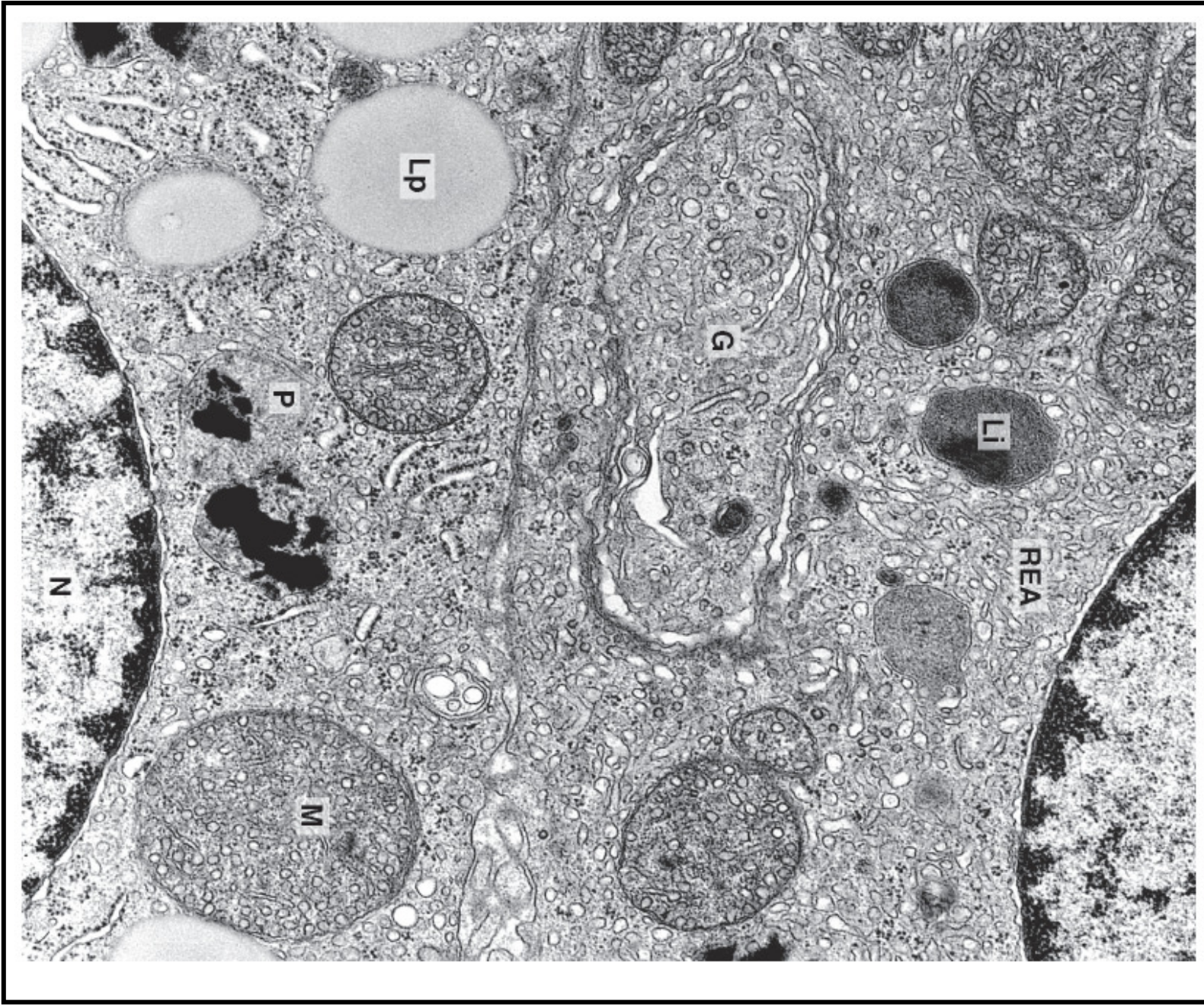
**Reticular**

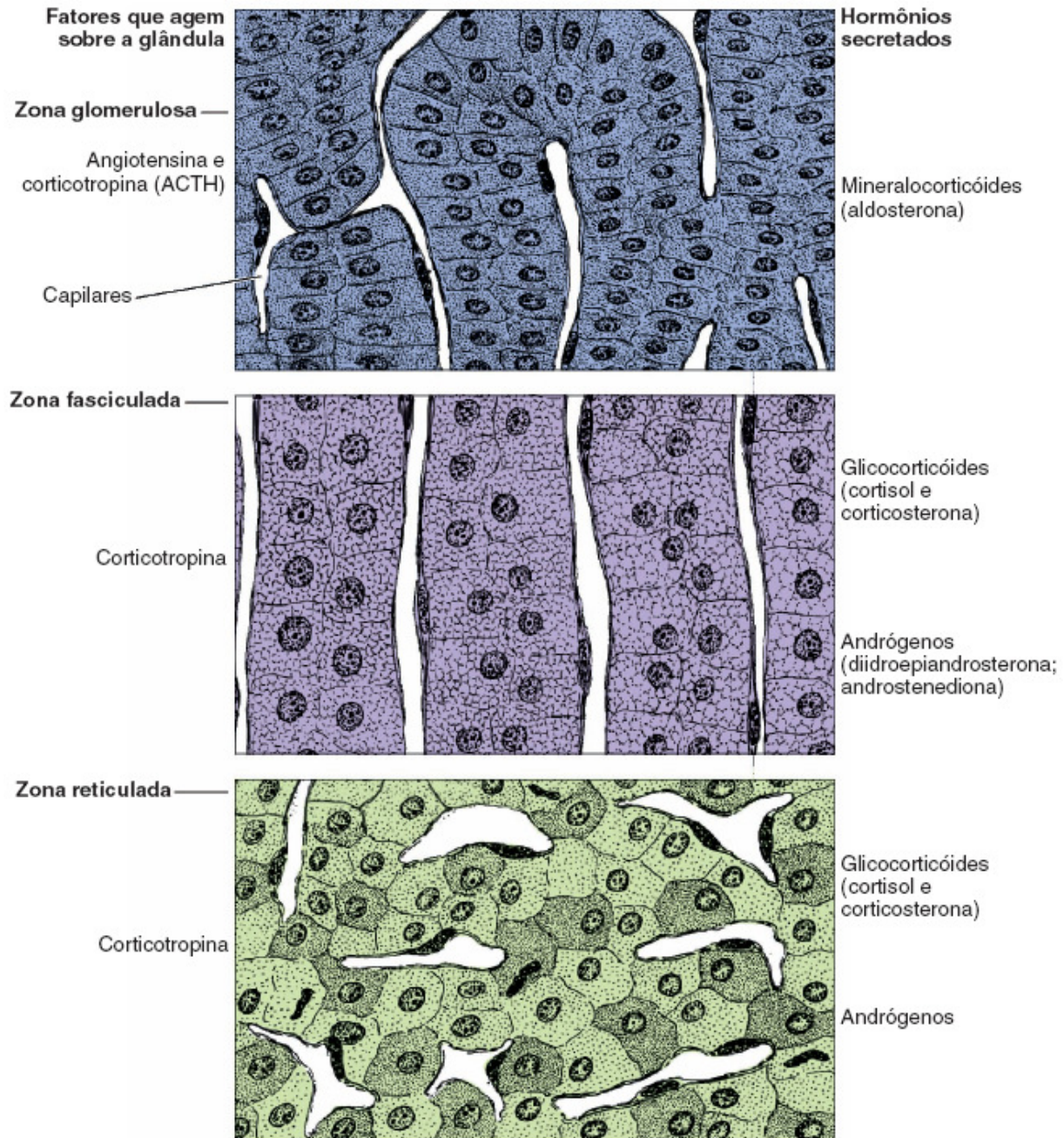
**Medular**











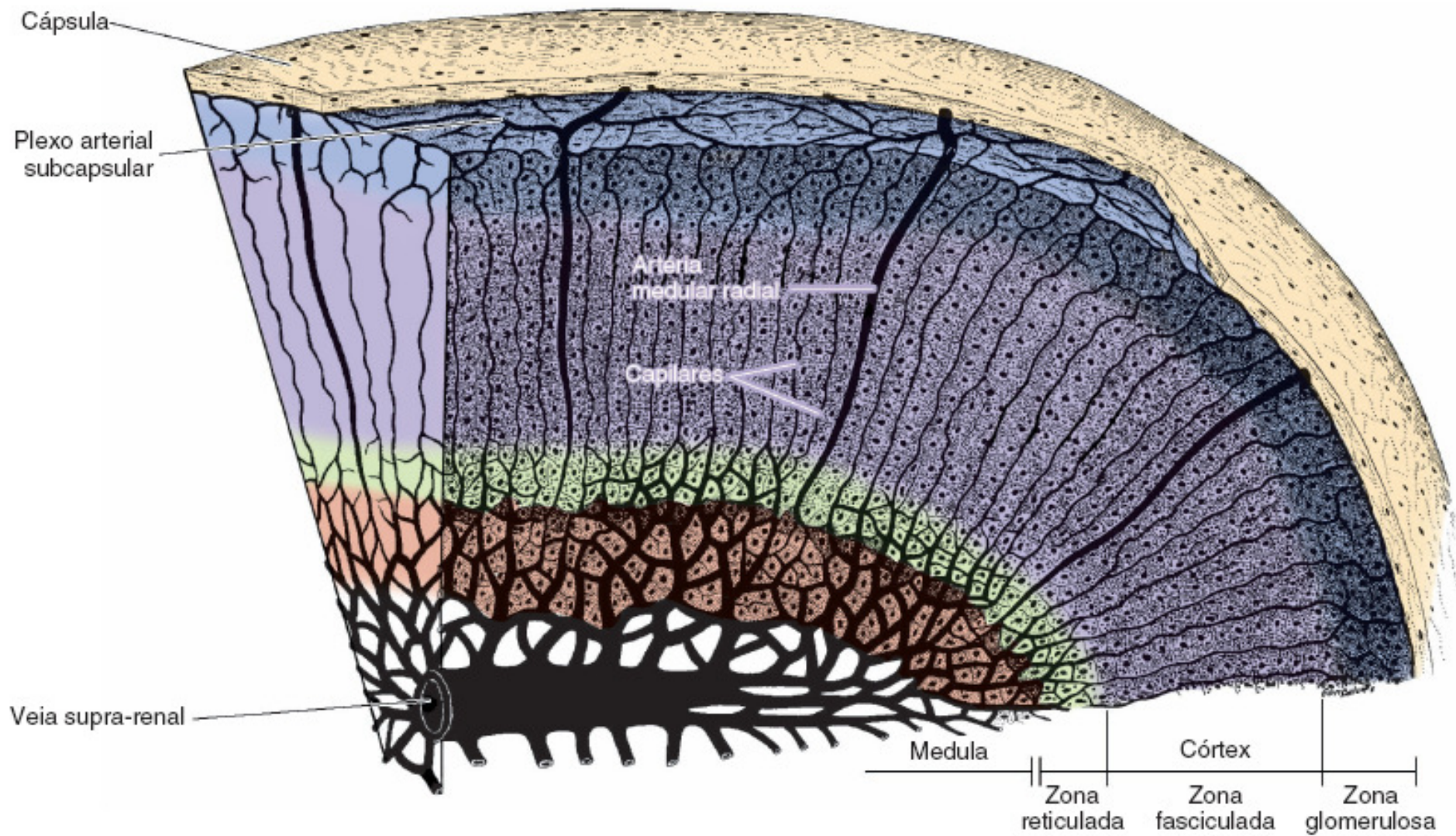
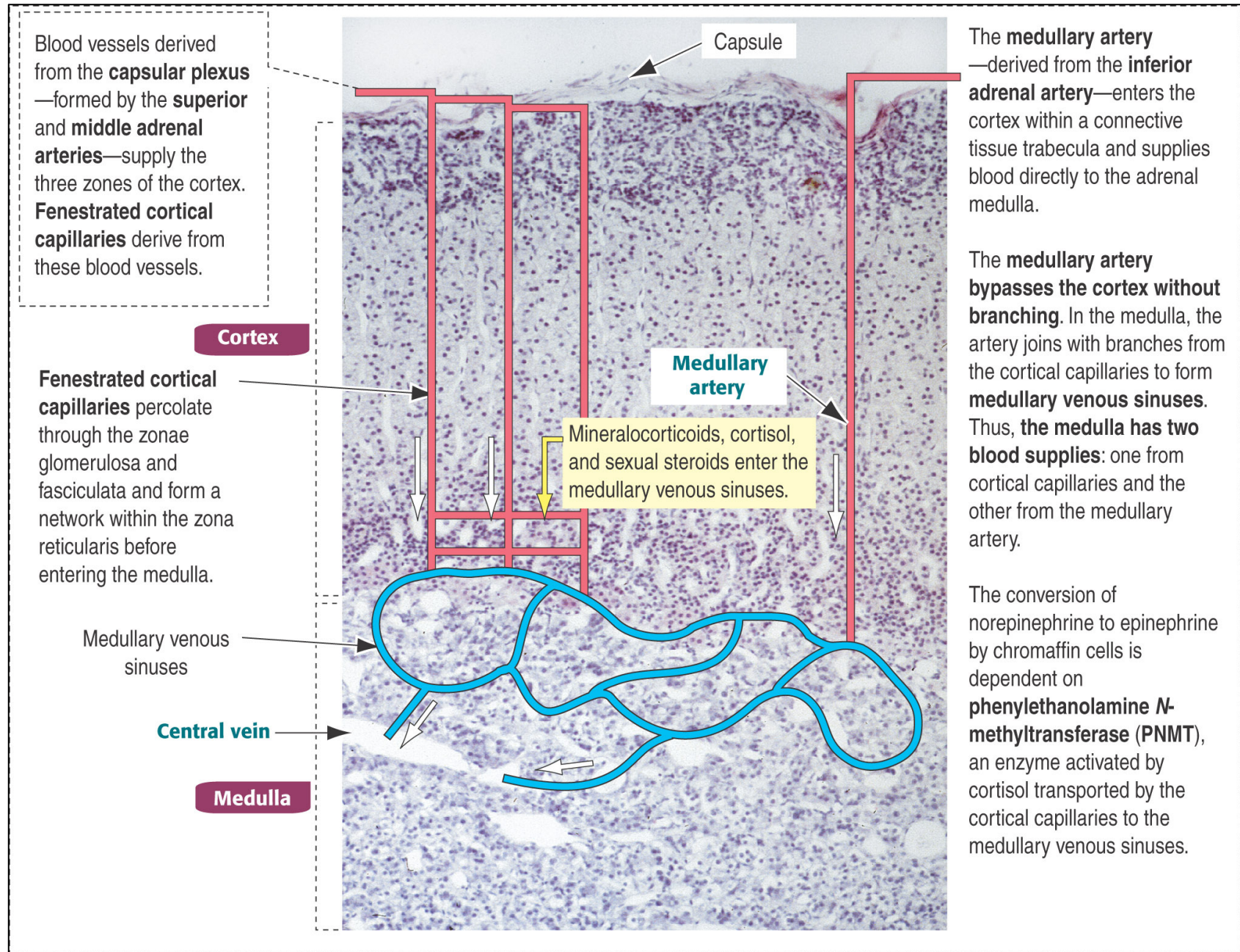


Fig. 20.11 Arquitetura geral e circulação de sangue na glândula adrenal.

# Sistema Endócrino - Adrenal



Blood vessels derived from the **capsular plexus**—formed by the **superior and middle adrenal arteries**—supply the three zones of the cortex. **Fenestrated cortical capillaries** derive from these blood vessels.

**Cortex**

**Fenestrated cortical capillaries** percolate through the zonae glomerulosa and fasciculata and form a network within the zona reticularis before entering the medulla.

Medullary venous sinuses

**Central vein**

**Medulla**

Capsule

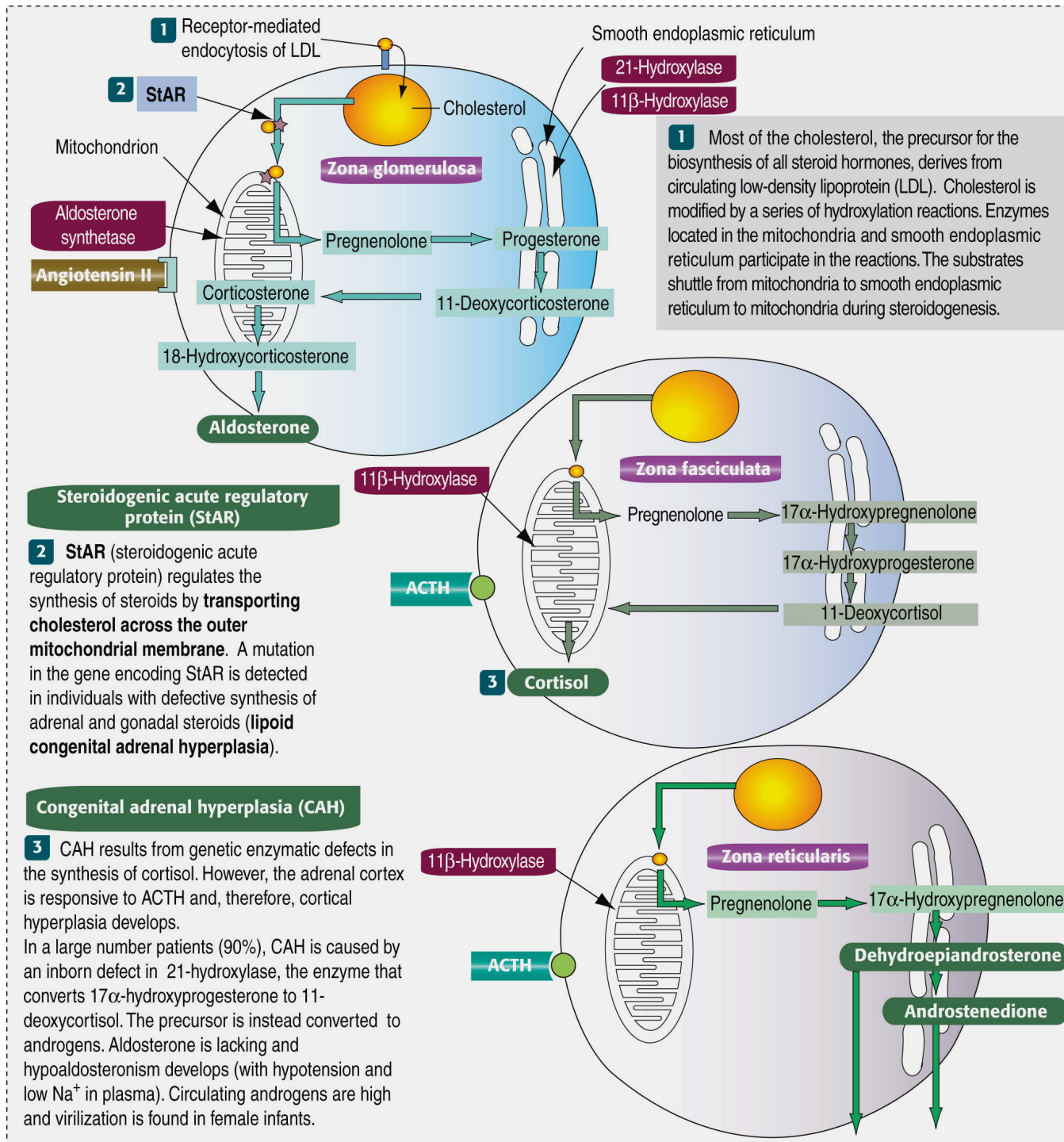
**Medullary artery**

Mineralocorticoids, cortisol, and sexual steroids enter the medullary venous sinuses.

The **medullary artery**—derived from the **inferior adrenal artery**—enters the cortex within a connective tissue trabecula and supplies blood directly to the adrenal medulla.

The **medullary artery bypasses the cortex without branching**. In the medulla, the artery joins with branches from the cortical capillaries to form **medullary venous sinuses**. Thus, **the medulla has two blood supplies**: one from cortical capillaries and the other from the medullary artery.

The conversion of norepinephrine to epinephrine by chromaffin cells is dependent on **phenylethanolamine N-methyltransferase (PNMT)**, an enzyme activated by cortisol transported by the cortical capillaries to the medullary venous sinuses.



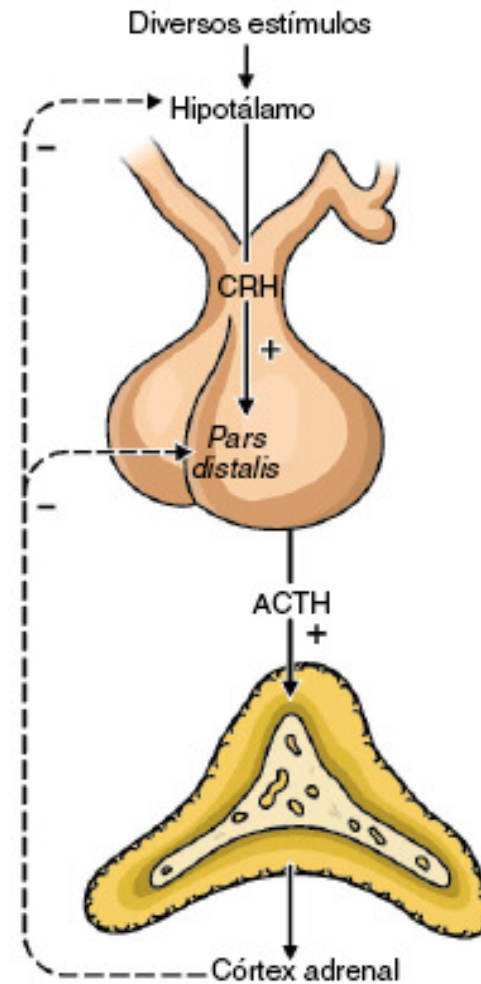


Fig. 20.15 Mecanismo de controle de secreção de ACTH e de glicocorticóides. CRH, hormônio libertador de corticotropina, ACTH, corticotropina.



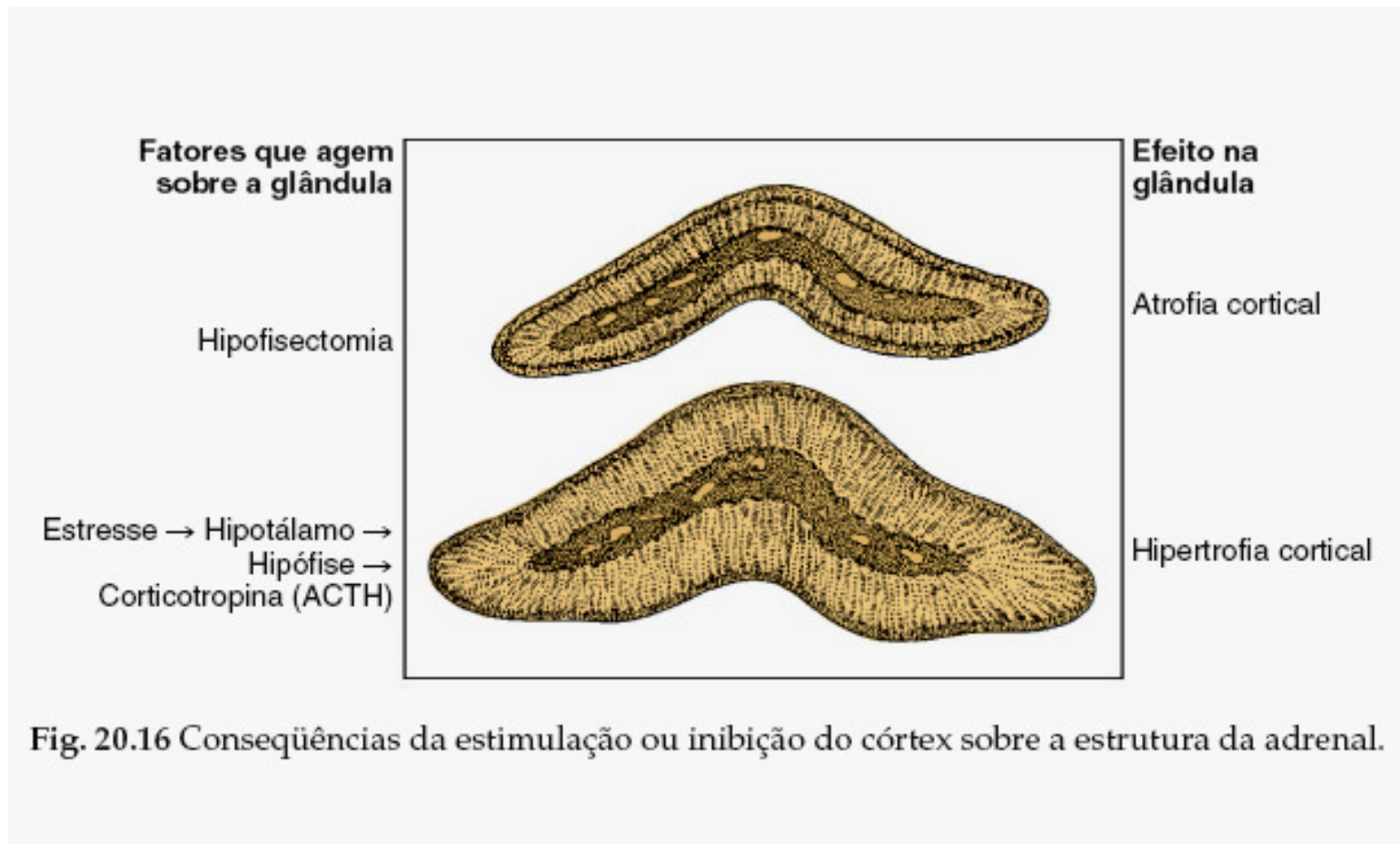
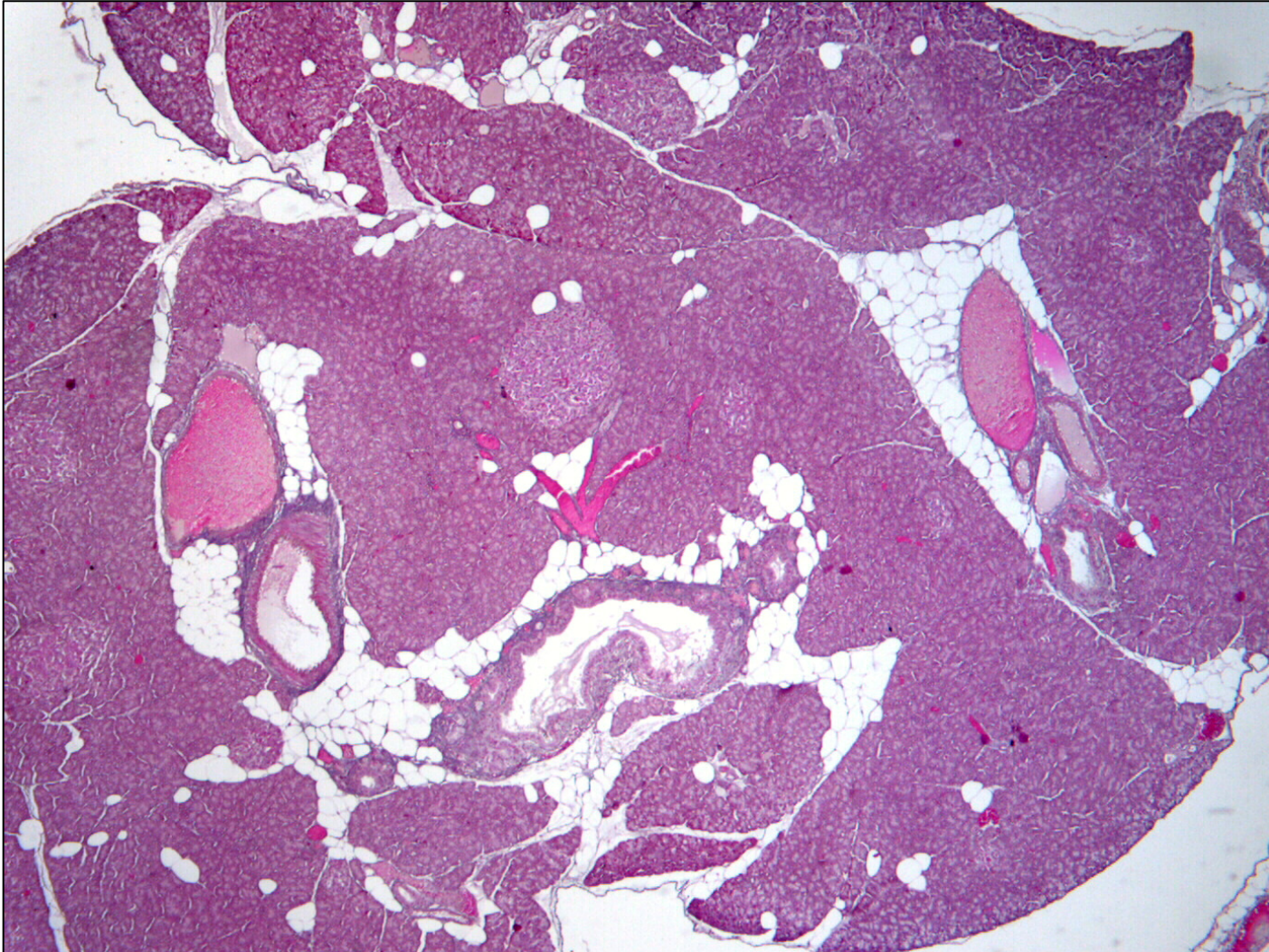
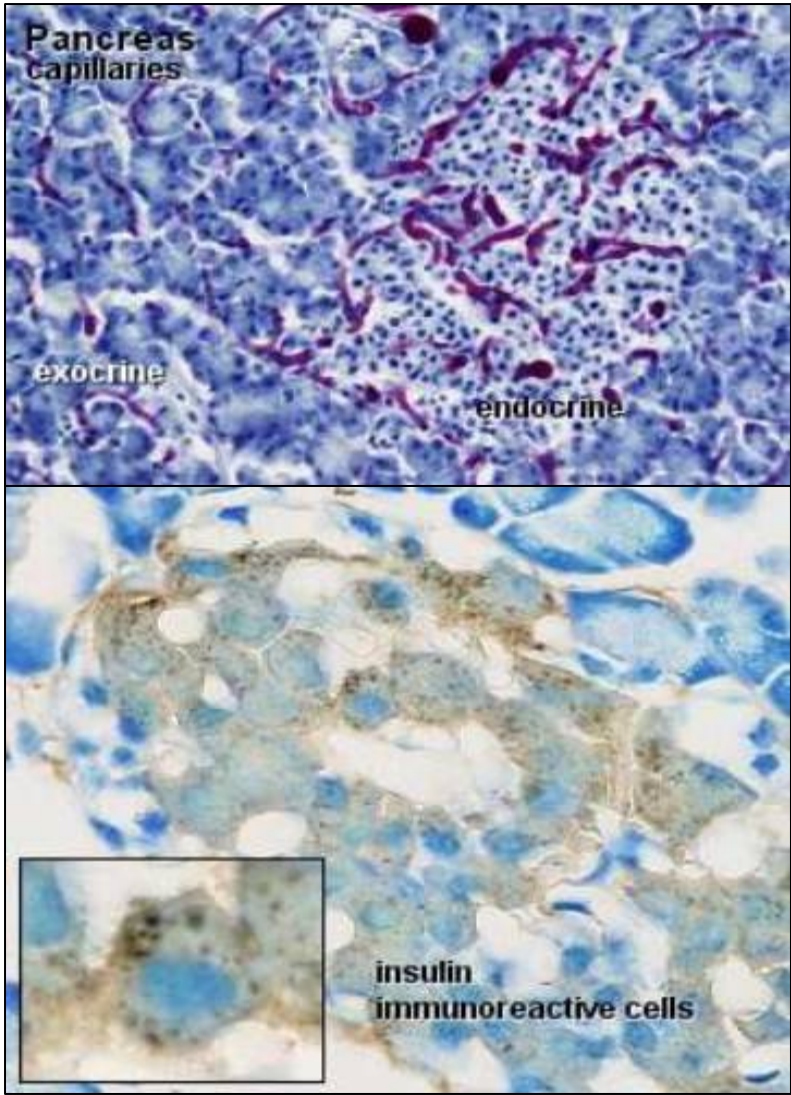
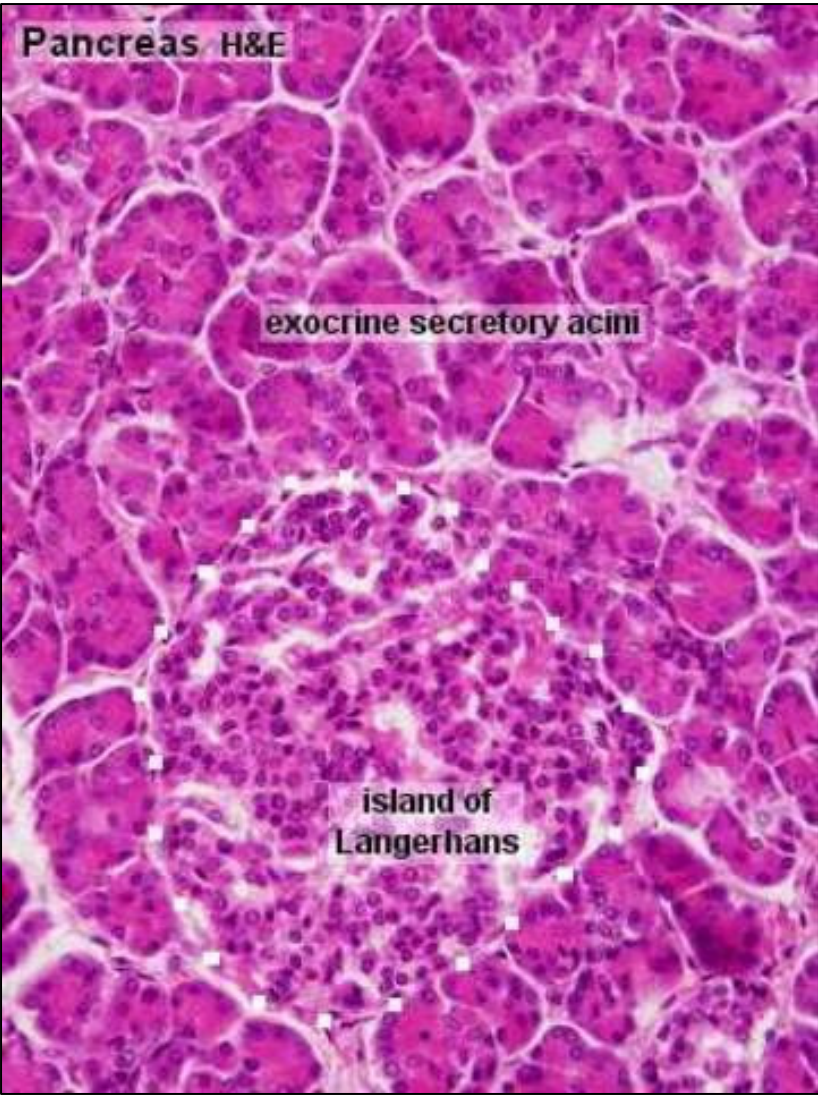


Fig. 20.16 Conseqüências da estimulação ou inibição do córtex sobre a estrutura da adrenal.

# Pâncreas



# Ilhotas de Langerhans

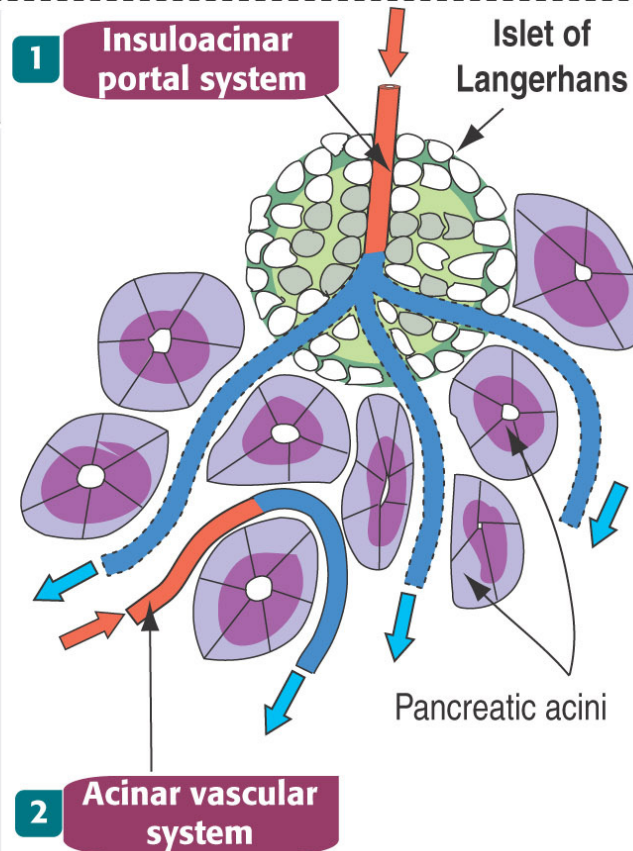


## Dual blood supply: Acinar and insuloacinar vascular systems

**1** Each islet of Langerhans is supplied by afferent arterioles, forming a network of capillaries lined by fenestrated endothelial cells. This network is called the **insuloacinar portal system**.

Capillaries leaving the islet supply blood to the pancreatic acini surrounding the islet. This vascular system enables a local action on the exocrine pancreas of hormones produced in the islet.

**2** An independent arterial system, the **acinar vascular system**, supplies the pancreatic acini.



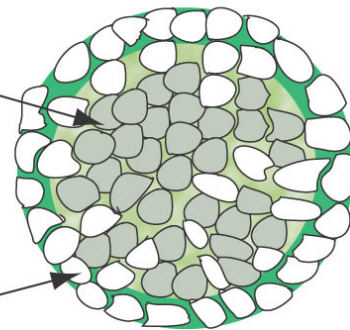
## Topographic distribution of endocrine cells in the islets of Langerhans

### Core

Beta cells predominate in the core.

### Mantle

Other cells—alpha, delta, and F cells—are present in the mantle.



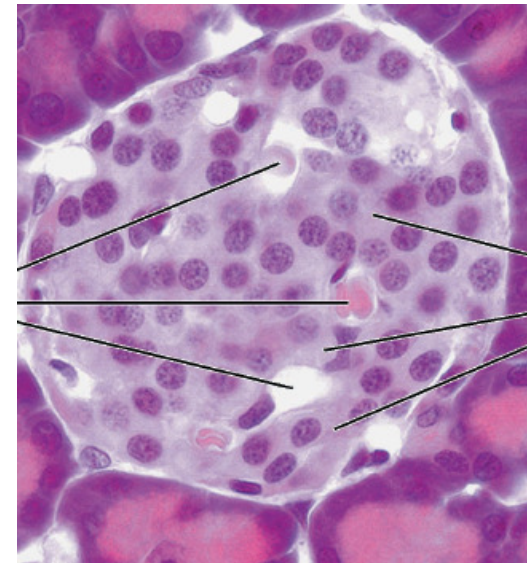
# Sistema Endócrino

## ➤ Ilhotas pancreáticas (Langerhans)

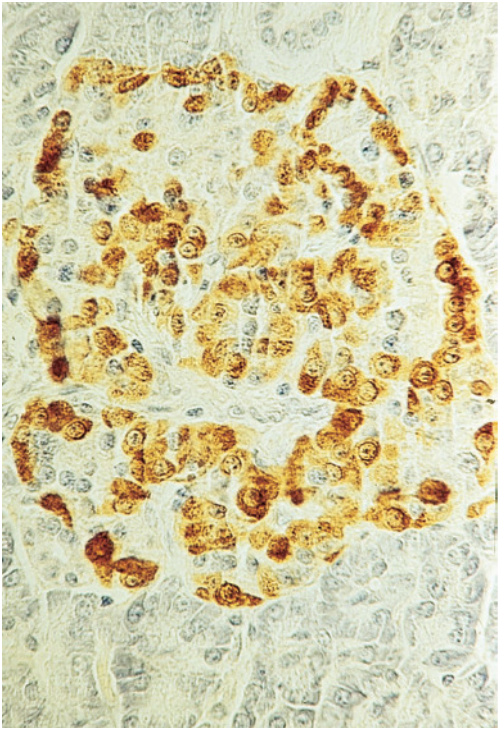
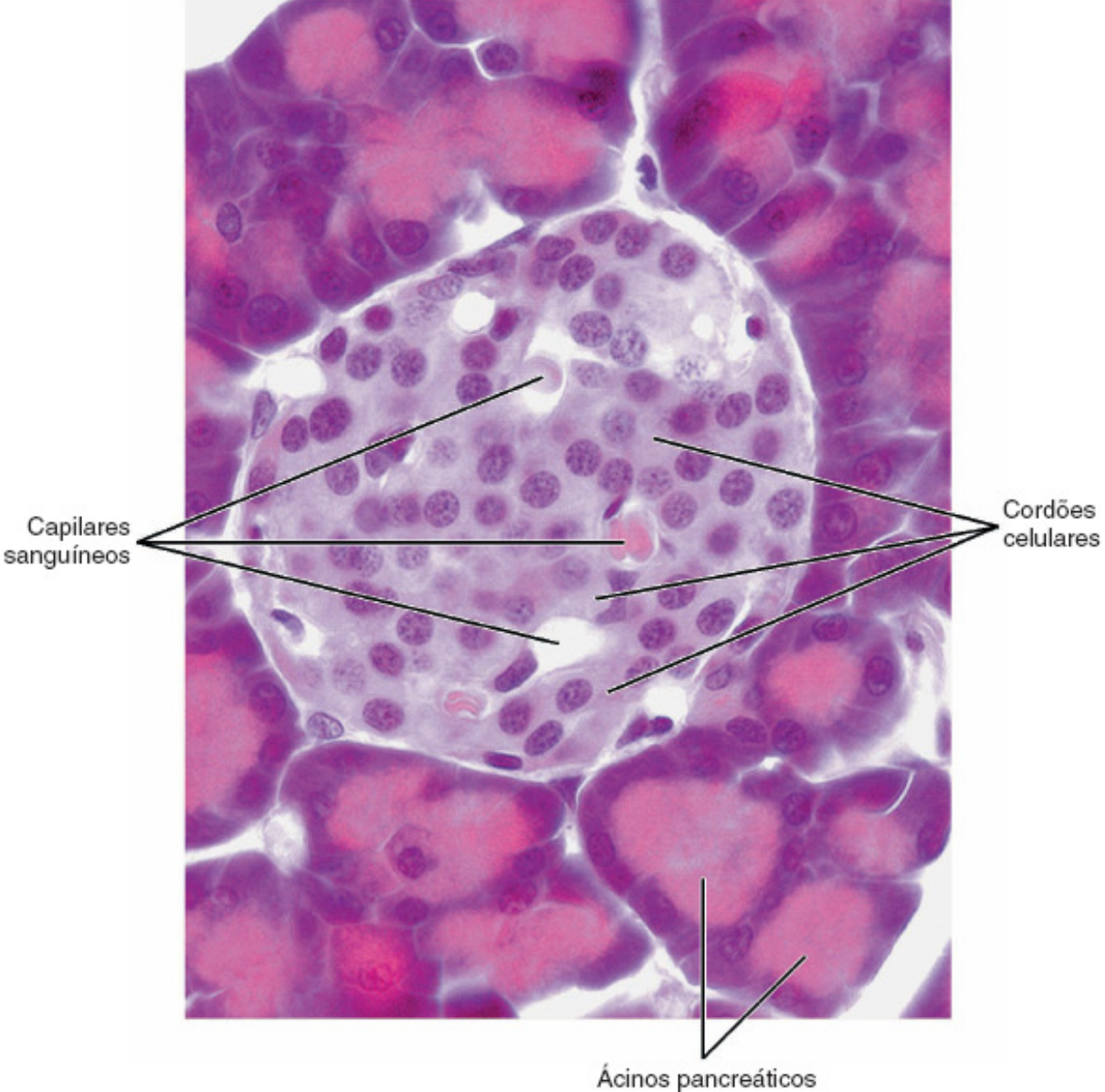
- pâncreas exócrino – ácinos e ductos pancreáticos
- pâncreas endócrino – Ilhotas de Langerhans
  - cerca de 1 milhão de Ilhotas por pâncreas
  - cordões de células entre capilares
  - cápsula de TC rico em fibras reticulares

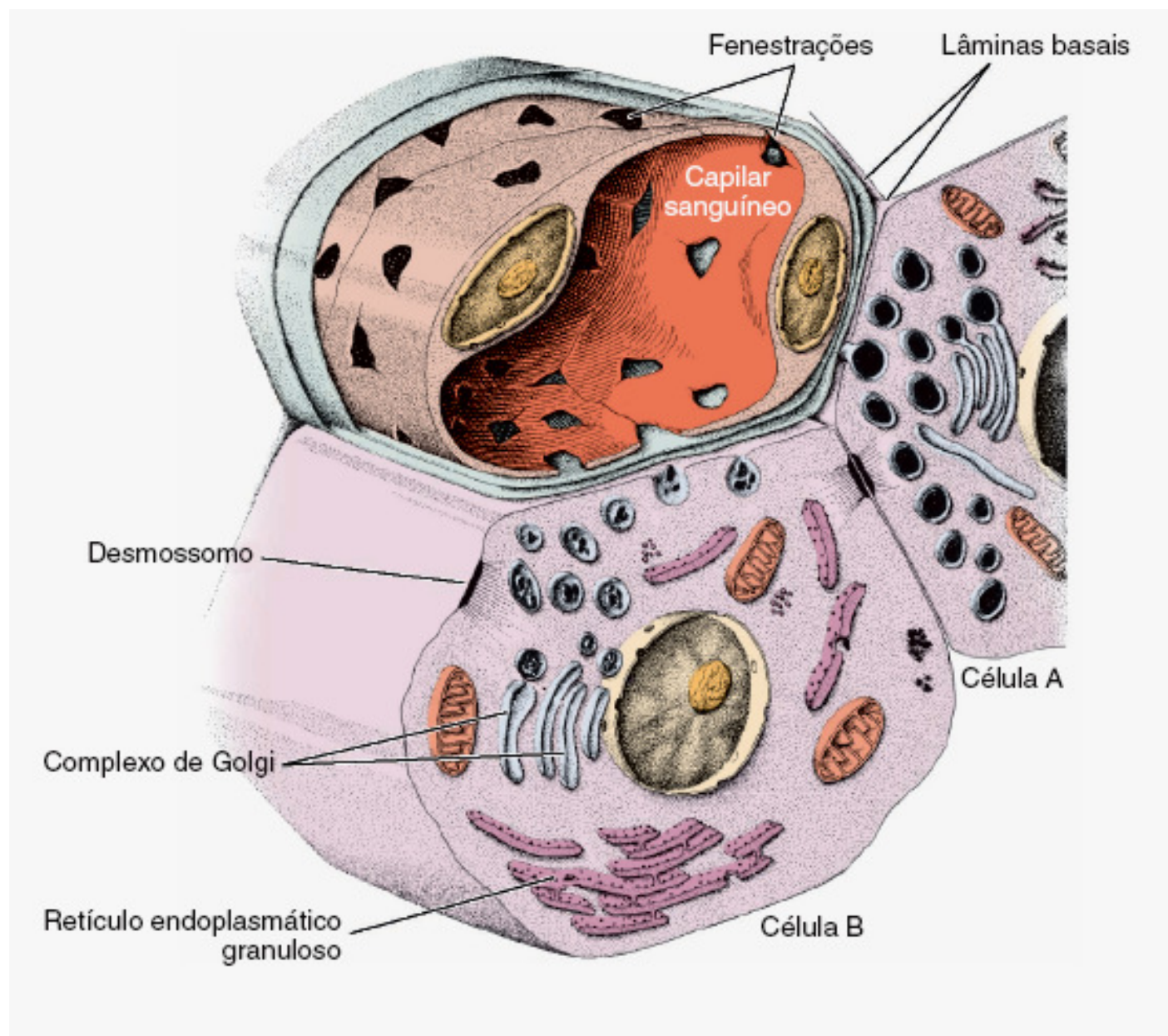
### Ilhotas de Langerhans (hormônios)

- tipos celulares:
  - alfa ( 15-20%) - glucagon
  - beta (70-80%) - insulina
  - delta (10%)- gastrina e somatostatina
  - F (2%) – polipeptídio pancreático
  - outras- VIP, motilina, secretina

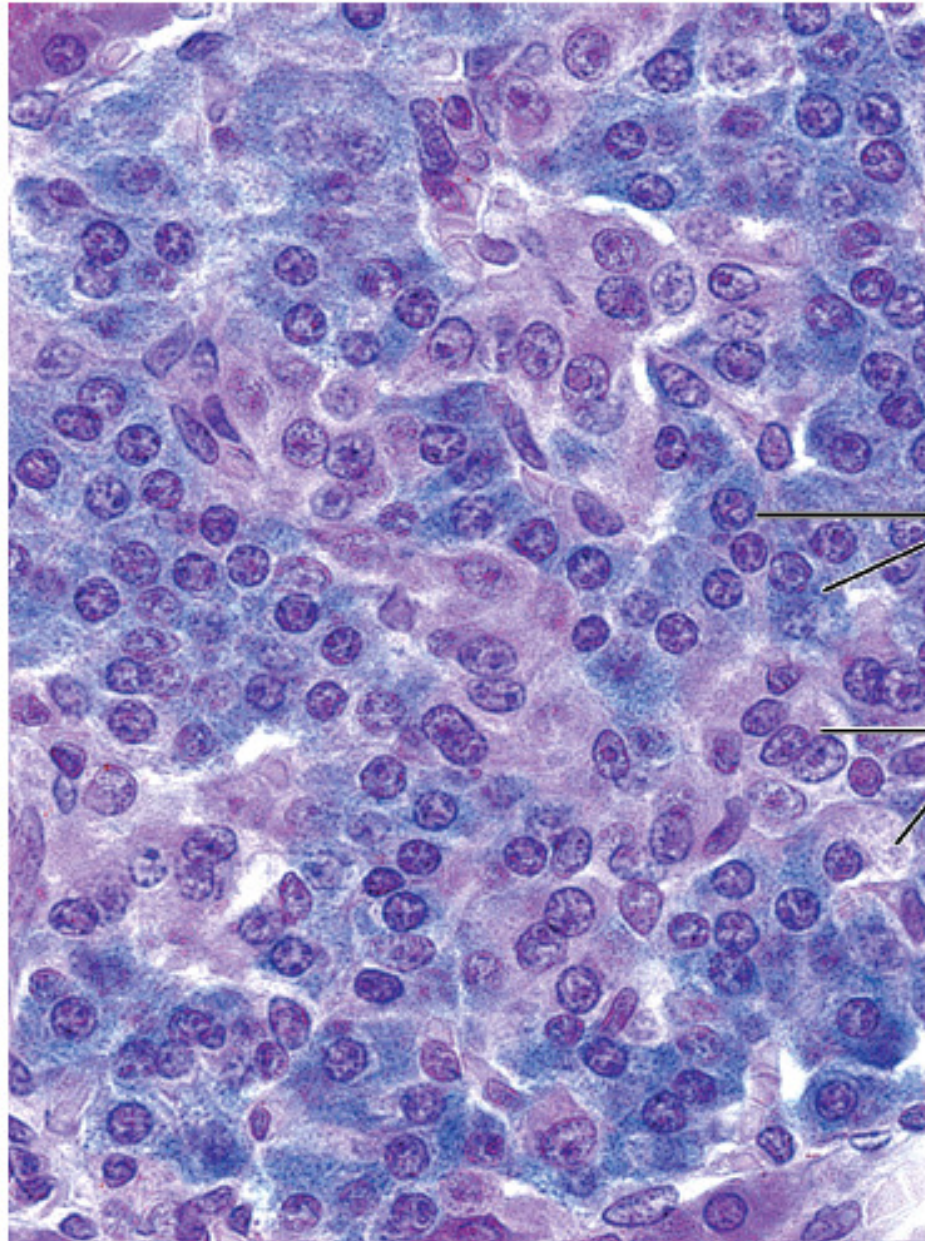


# Ilhotas de Langerhans





# Ilhotas de Langerhans

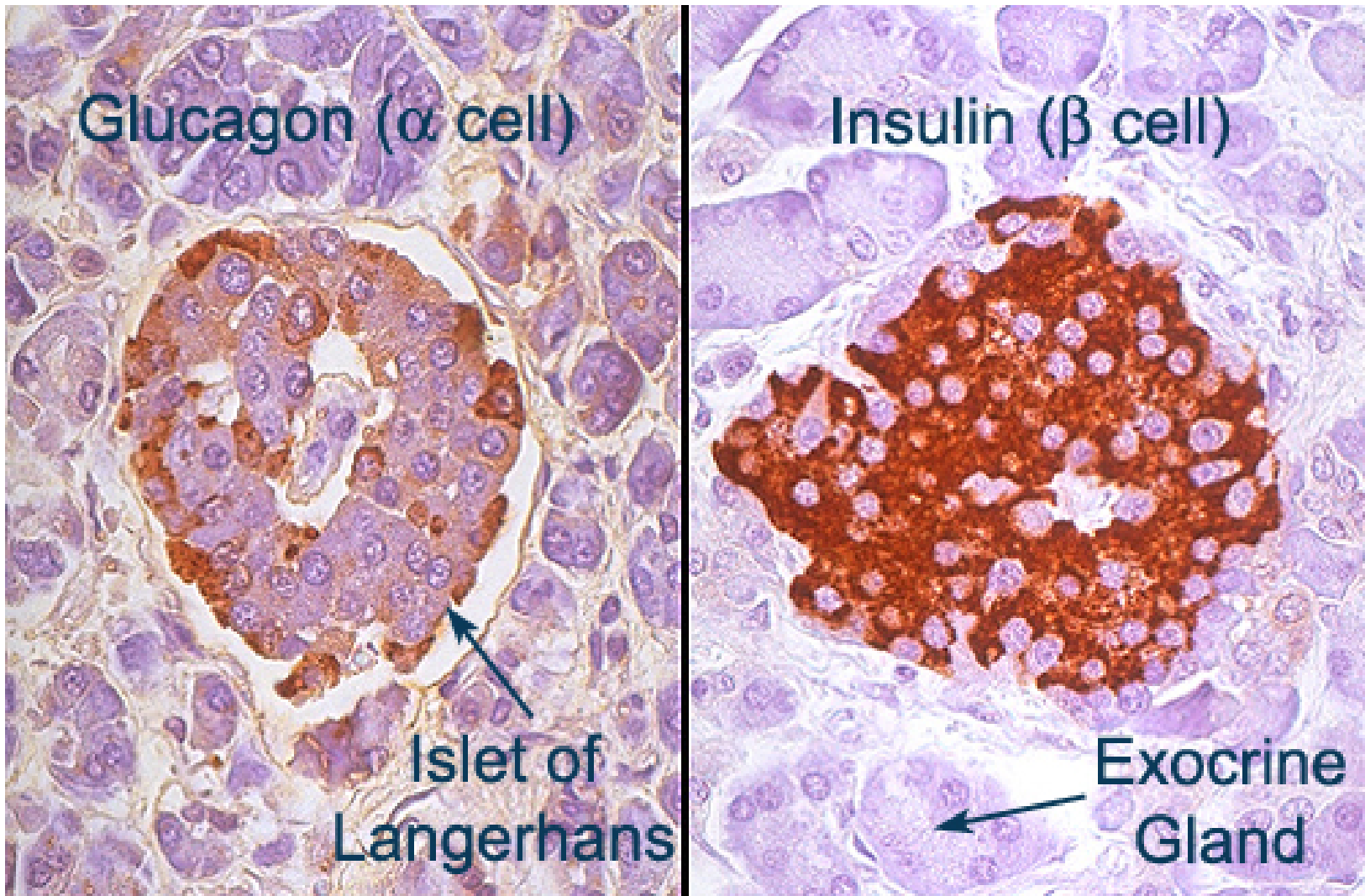


Células B Insulina

Células A Glucagon



# PÂNCREAS (ILHOTAS DE LANGERHANS)



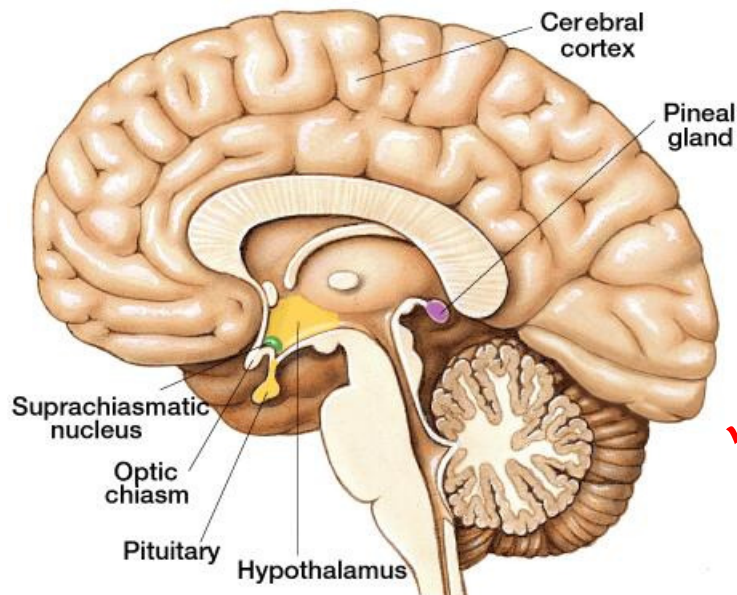
CÉLULA  $\alpha$

CÉLULA  $\beta$

# Sistema Endócrino

## ➤ Pineal (Epífise)

- glândula de função neuroendócrina
  - pinealócitos (melatonina, serotonina) e astrócitos
  - células intersticiais (semelhantes a células gliais)
  - vasos sanguíneos, revestida externamente pelas meninges – pia mater
  - corpora arenacea “areia cerebral” – depósitos de carbonato de cálcio em adultos na MEC



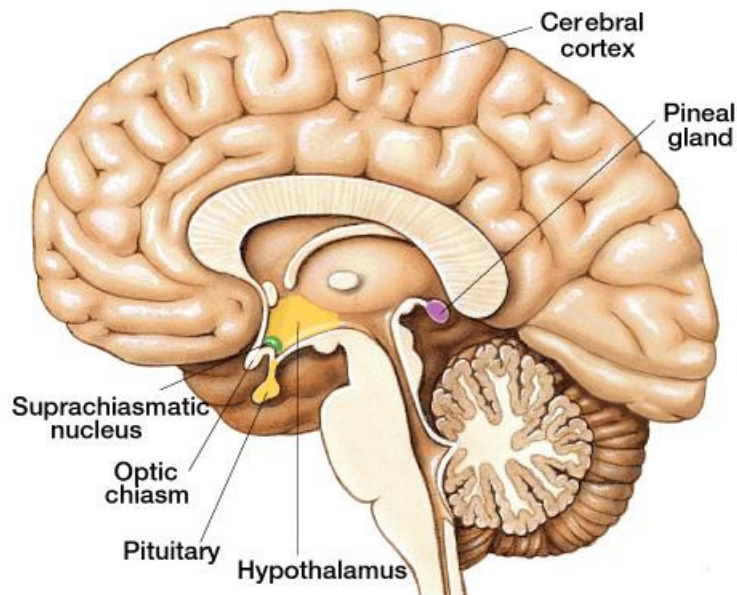
**Localiza-se na extremidade posterior do terceiro ventrículo sobre o teto do diencéfalo**

**✓ FUNÇÃO:** Controle dos ritmos circadianos

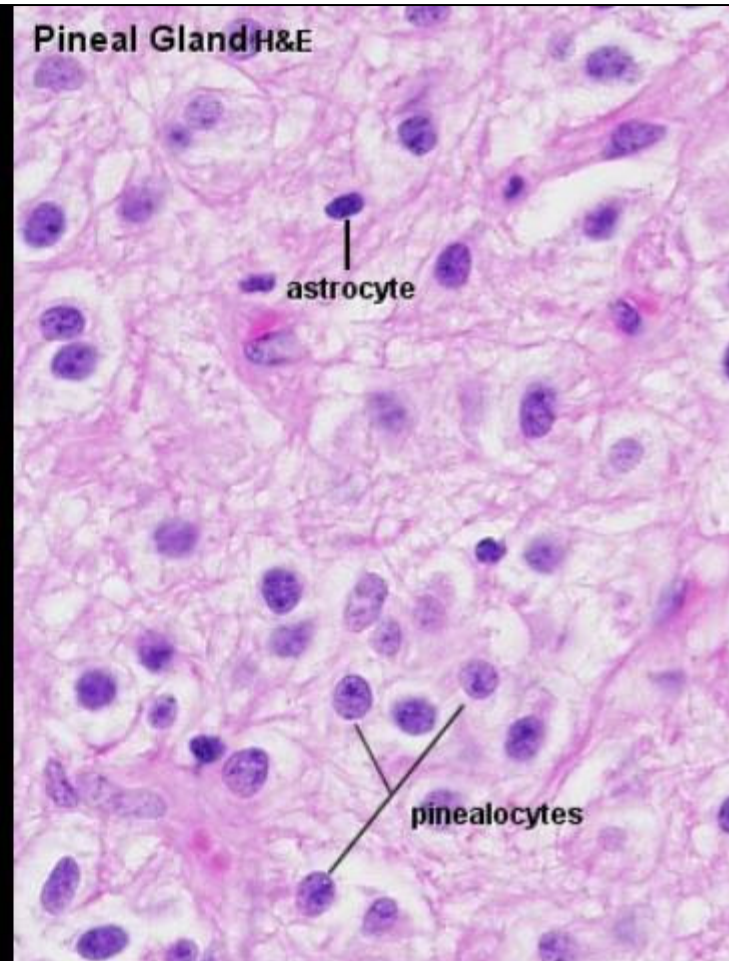
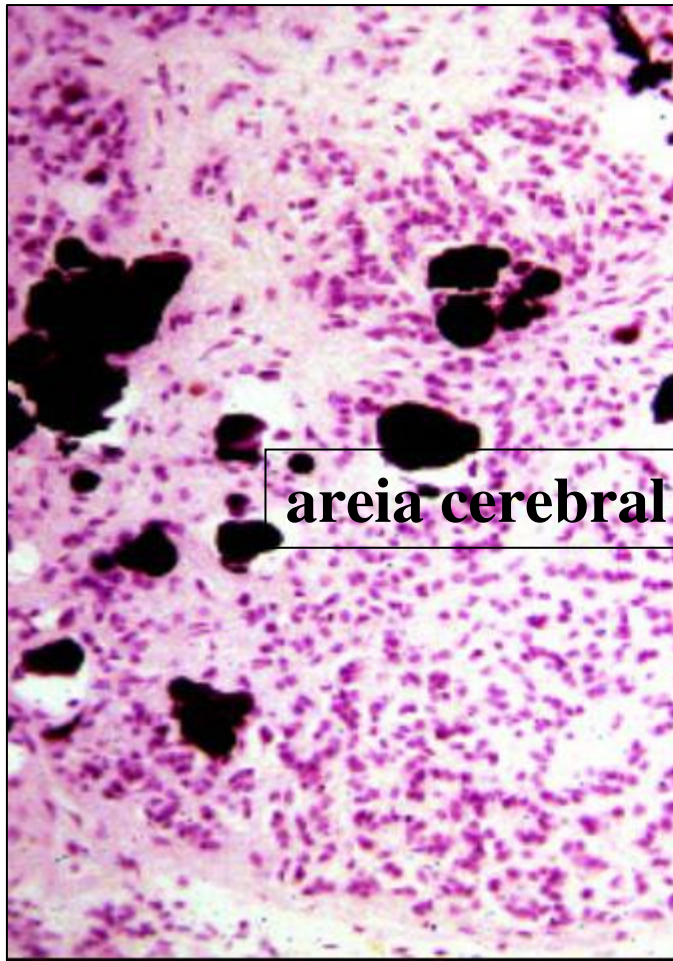
# Sistema Endócrino

## ➤ Pineal (Epífise)

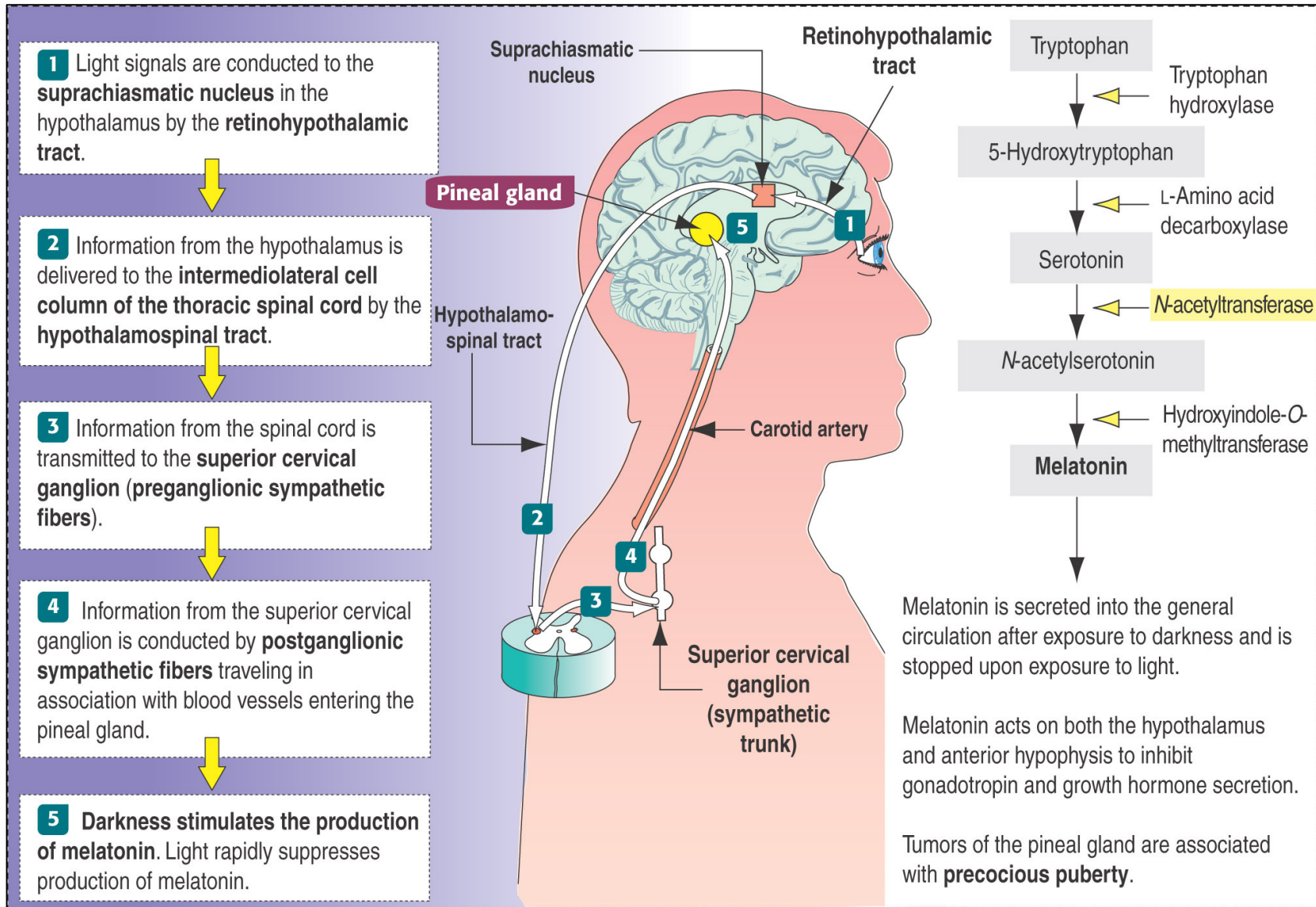
- glândula de função neuroendócrina
  - pinealócitos (melatonina, serotonina) e astrócitos
  - células intersticiais (semelhantes a células gliais)
  - vasos sanguíneos, revestida externamente pelas meninges
  - corpora arenacea “areia cerebral” – depósitos de carbonato de cálcio em adultos na MEC



# Sistema Endócrino



# Sistema Endócrino: Melatonina



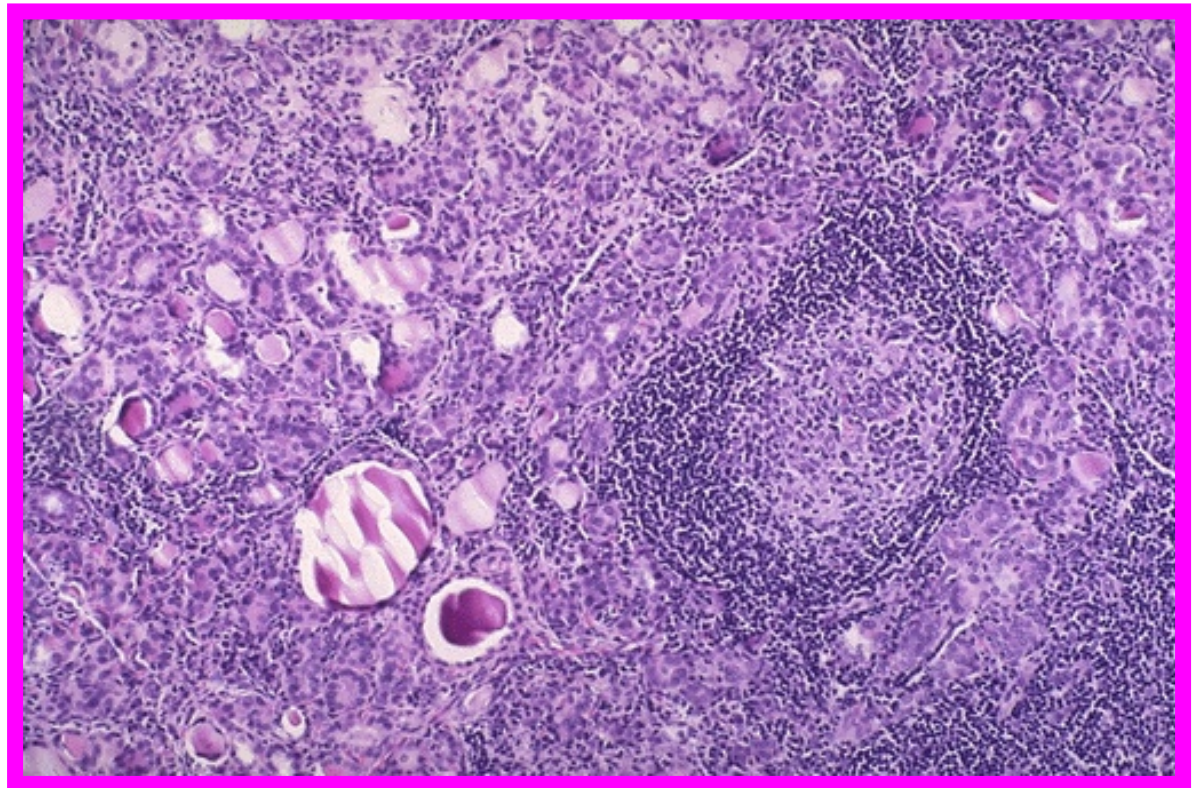
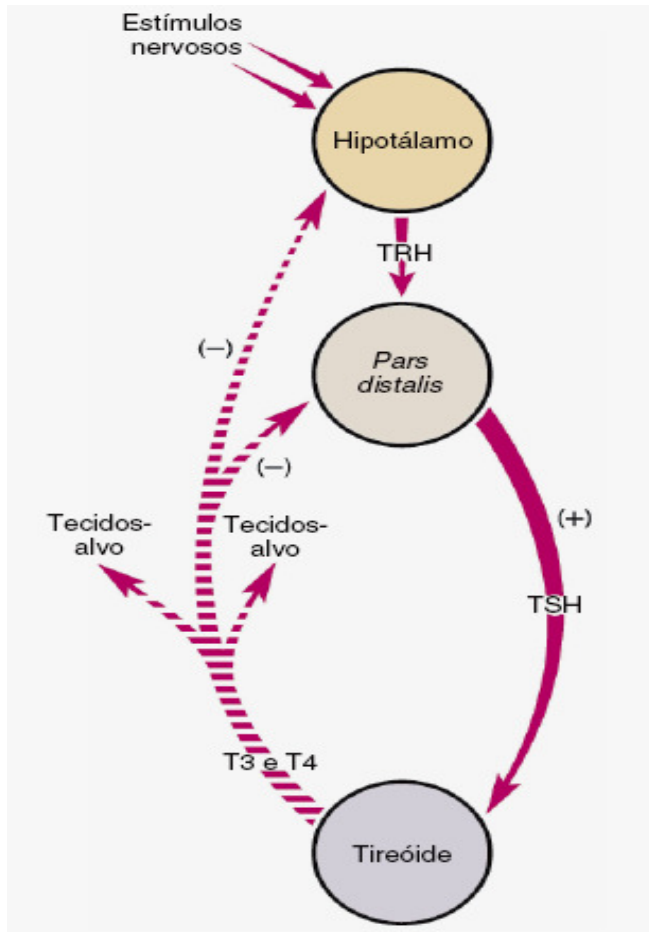
# TIREÓIDE

## ALTERAÇÃO DE FUNÇÃO

- HIPOFUNÇÃO (HIPOTIREOIDISMO)
- HIPERFUNÇÃO (HIPOTIREOIDISMO)

# HIPOTIREOIDISMO

## TIREOIDITE DE HASHIMOTO



# HIPOTIREOIDISMO

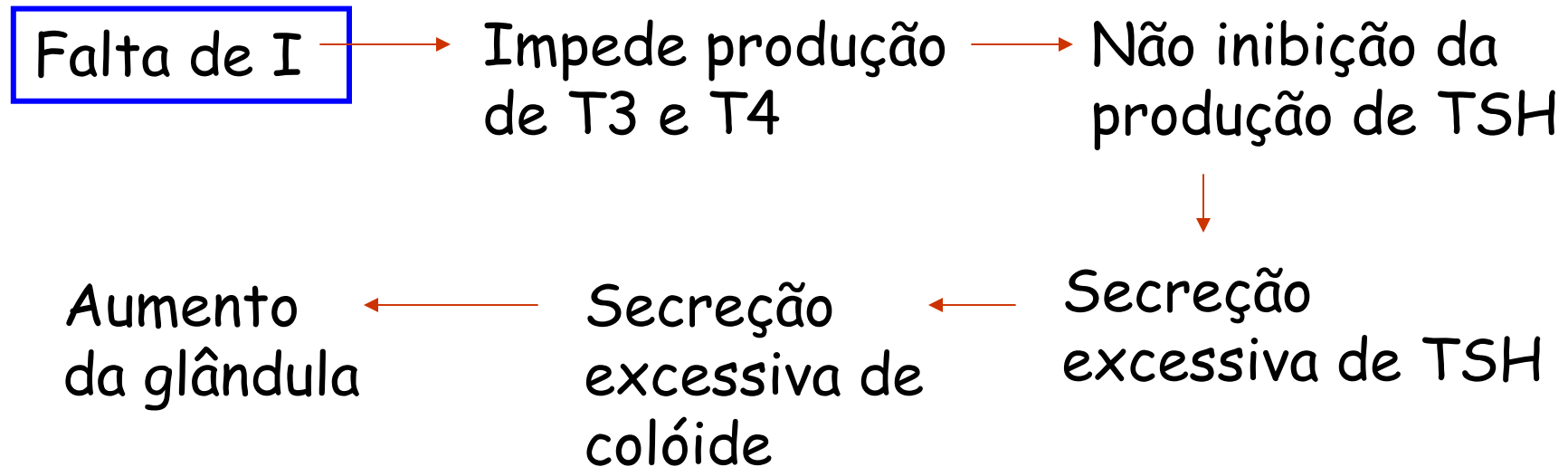
## Bócio colóide endêmico

Desenvolvimento de um tamanho aumentado da glândula tireóide devido à falta de Iodo.

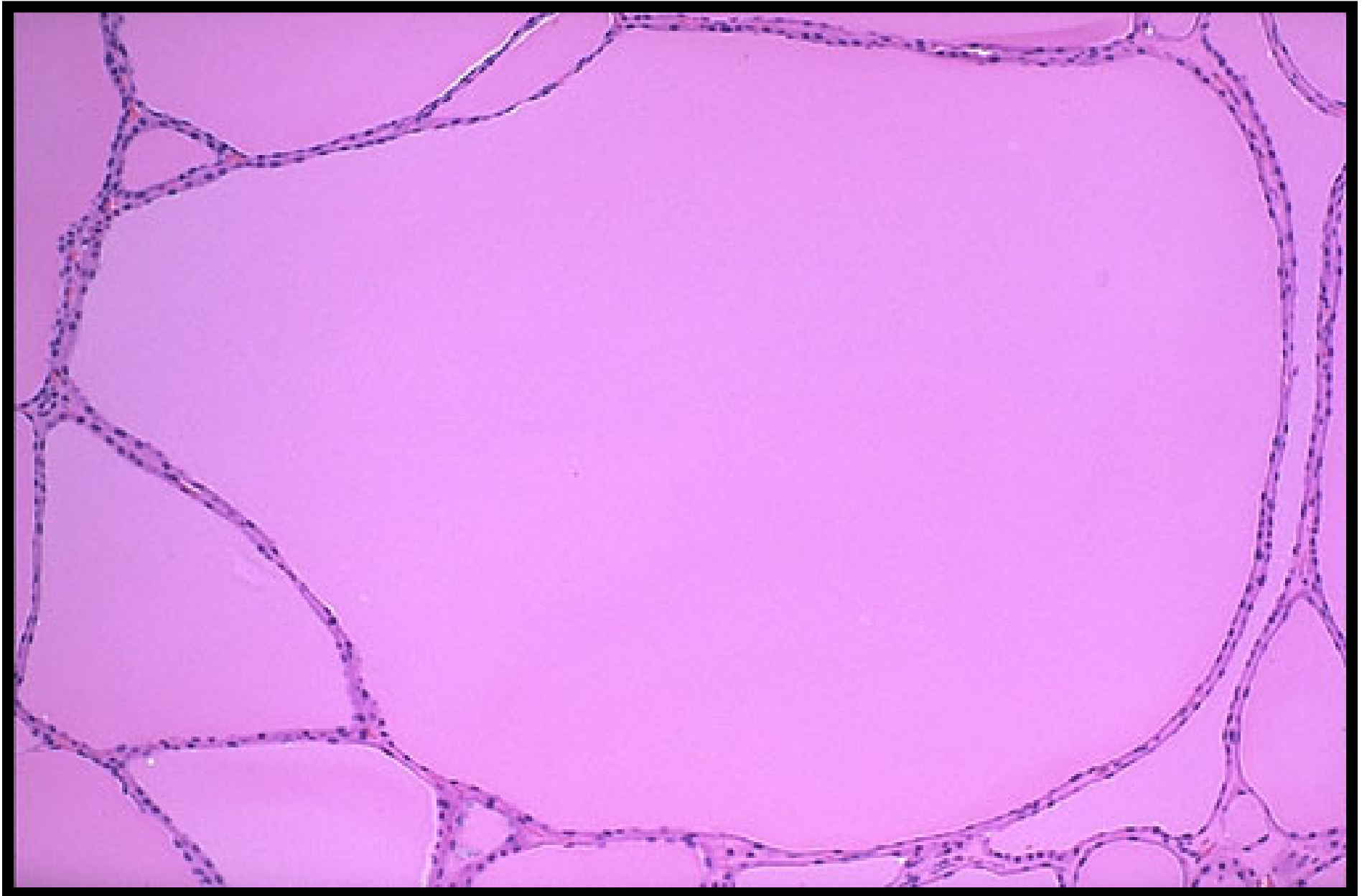


# Bócio colóide endêmico

50mg I/ano → Quantidades adequadas de hormônios tireoidianos



# Bócio colóide endêmico

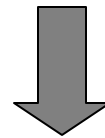


# HIPERTIREOIDISMO

## Doença de Graves

- Mecanismo é **autoimune**
- Produção de **anticorpos contra os receptores para TSH** situados na membrana plasmática das células foliculares.

**Anticorpos + Receptor = TSH + Receptor**



**célula folicular é estimulada a secretar T3 e T4.**

# Doença de Graves

**Anticorpos estimulam a secreção de T3 e T4, assim como o TSH**



**Células foliculares** tornam-se grandes, cilíndricas ou cúbicas, com núcleos volumosos, devido à sua **maior atividade**

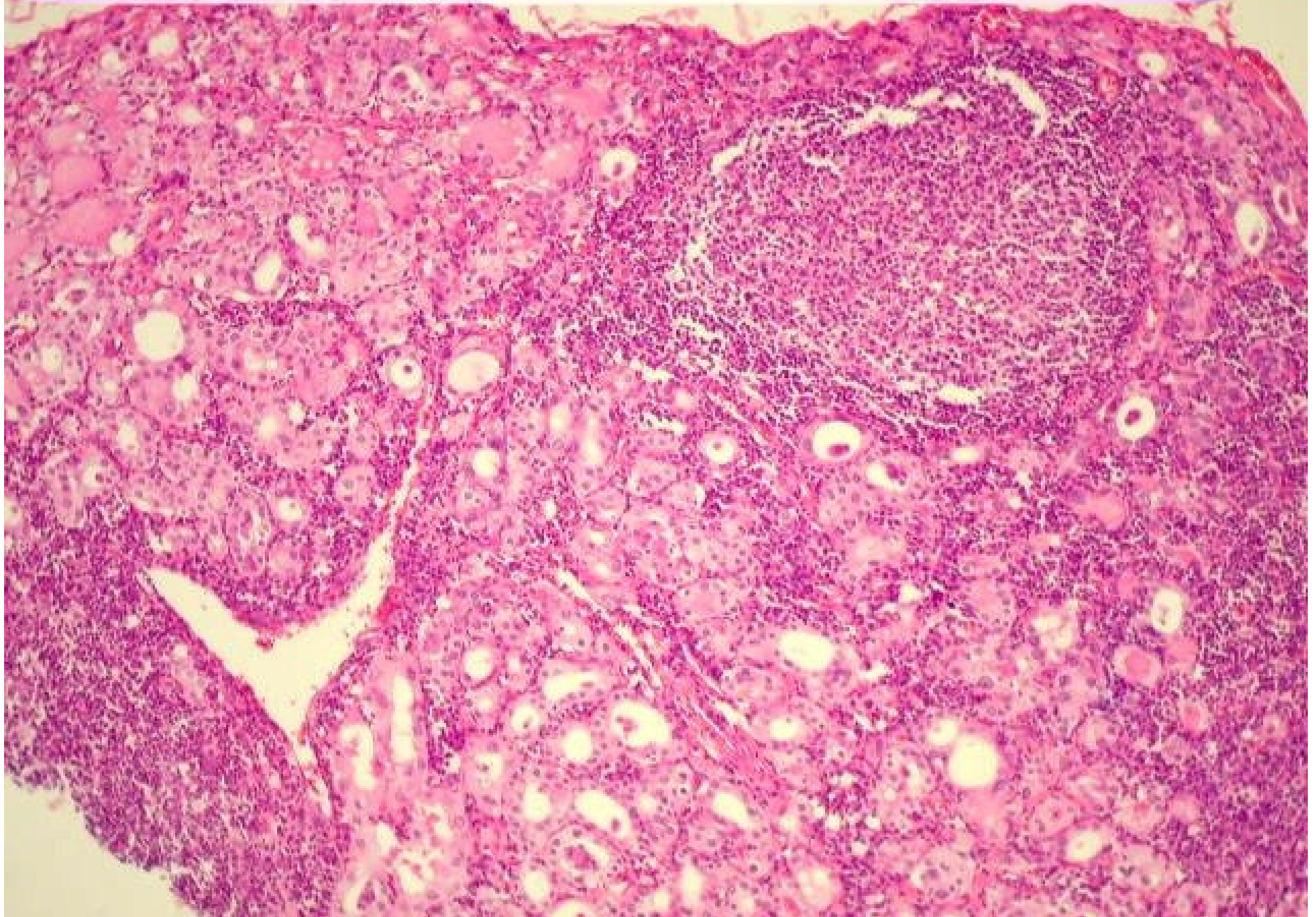


**Quantidade de colóide** na luz dos folículos **fica pequena**



célula **metaboliza o colóide** para liberar T3 e T4 no sangue circulante

# FOLÍCULOS PEQUENOS COM POUCO COLOIDE



# Doença de Graves

## Infiltrado inflamatório

Há infiltrado linfoplasmocitário focal, formando folículos linfóides com centros germinativos. O infiltrado inflamatório é a expressão morfológica da natureza autoimune da doença.

