

**M U N I**  
**M E D**

# **Endocrine function of selected organs and tissues**

# Hormones synthesized and secreted by dedicated endocrine glands

## □ Pituitary Gland

- Growth hormone (GH)
- Prolactin
- Adrenocorticotrophic hormone (ACTH)
- Thyroid-stimulating hormone (TSH)
- Follicle-stimulating hormone (FSH)
- Luteinizing hormone (LH)

## □ Thyroid Gland

- Tetraiodothyronine (T4; thyroxine)
- Triiodothyronine (T3)
- Calcitonin

## □ Parathyroid Glands

- Parathyroid hormone (PTH)

## □ Pancreas (Islets of Langerhans)

- Insulin
- Glucagon
- Somatostatin

## □ Adrenal Gland

- Epinephrine
- Norepinephrine
- Cortisol
- Aldosterone
- Dehydroepiandrosterone sulfate (DHEAS)

## □ Hormones Synthesized by Gonads

- **Ovaries**
- Estradiol-17 $\beta$
- Progesterone
- Inhibin
- **Testes**
- Testosterone
- Antimüllerian hormone (AMH)
- Inhibin

# Hormones synthesized in organs with a primary function other than endocrine

## □ Brain (Hypothalamus)

- Antidiuretic hormone (ADH)
- Oxytocin
- Corticotropin-releasing hormone (CRH)
- Thyrotropin-releasing hormone
- Gonadotropin-releasing hormone (GnRH)
- Growth hormone–releasing hormone (GHRH)
- Somatostatin
- Dopamine

## □ Brain (Pineal Gland)

- Melatonin

## □ Heart

- Atrial natriuretic peptide (ANP)

## □ Kidney

- Erythropoietin

## □ Adipose Tissue

- Leptin
- Adiponectin

## □ Stomach

- Gastrin
- Somatostatin
- Ghrelin
- Intestines
- Secretin
- Cholecystokinin
- Glucagon-like peptide-1 (GLP-1)
- Glucagon-like peptide-2 (GLP-2)
- Glucose-dependent insulinotropic peptide (GIP; gastrin inhibitory peptide)
- Motilin

## □ Liver

- Insulin-like growth factor-I (IGF-I)

# Hormones Produced to a Significant Degree by Peripheral Conversion

## □ Lungs

- Angiotensin II

## □ Kidney

- 1 $\alpha$ ,25-dihydroxyvitamin D

## □ Adipose, Mammary Glands

- Estradiol-17 $\beta$

## □ Liver

- Testosterone

## □ Genital Skin, Prostate, Sebaceous Gland

- 5-Dihydrotestosterone (DHT)

## □ Many Organs

- T3

# Cardiovascular endocrinology

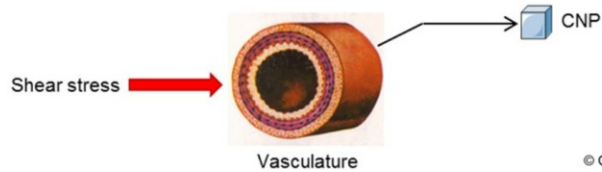
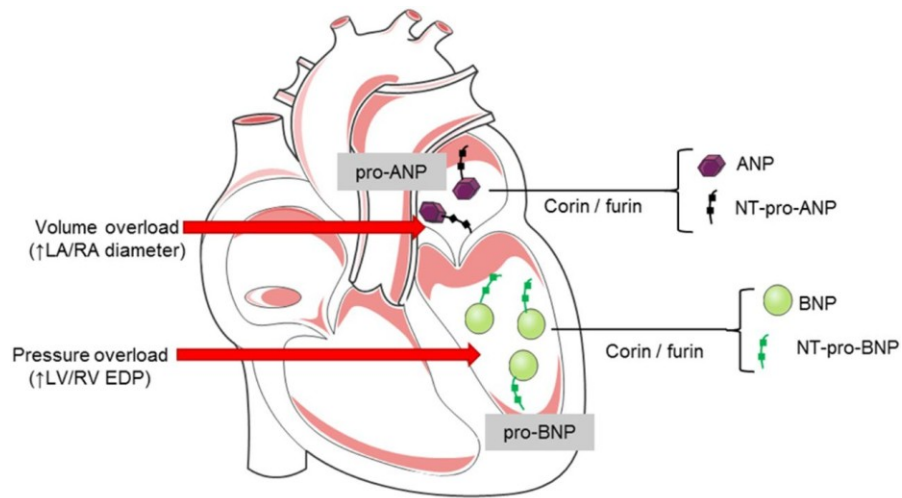
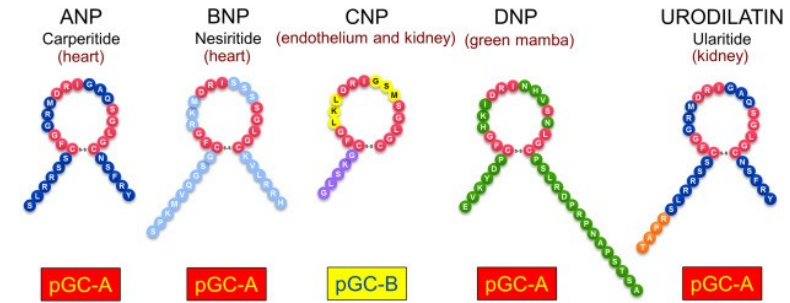
Endocrine hormones	<b>ANP</b>	Natriuresis and vasodilation
	<b>BNP</b>	Natriuresis and vasodilation
	GDF-15	Inhibiting body growth
	Myostatin	Reducing skeletal muscle mass
Autocrine/paracrine factors	<b>CNP</b>	Vasodilation
	Activin A	Protecting cardiomyocyte
	<b>ET-1</b>	Promoting cardiomyocyte survival
	IL-33	Antihypertrophic and antifibrosis

ANP = atrial natriuretic peptide; BNP = brain natriuretic peptide; CNP = C-type natriuretic peptide; ET = endothelin; GDF = growth differentiation factor; IL = interleukin;

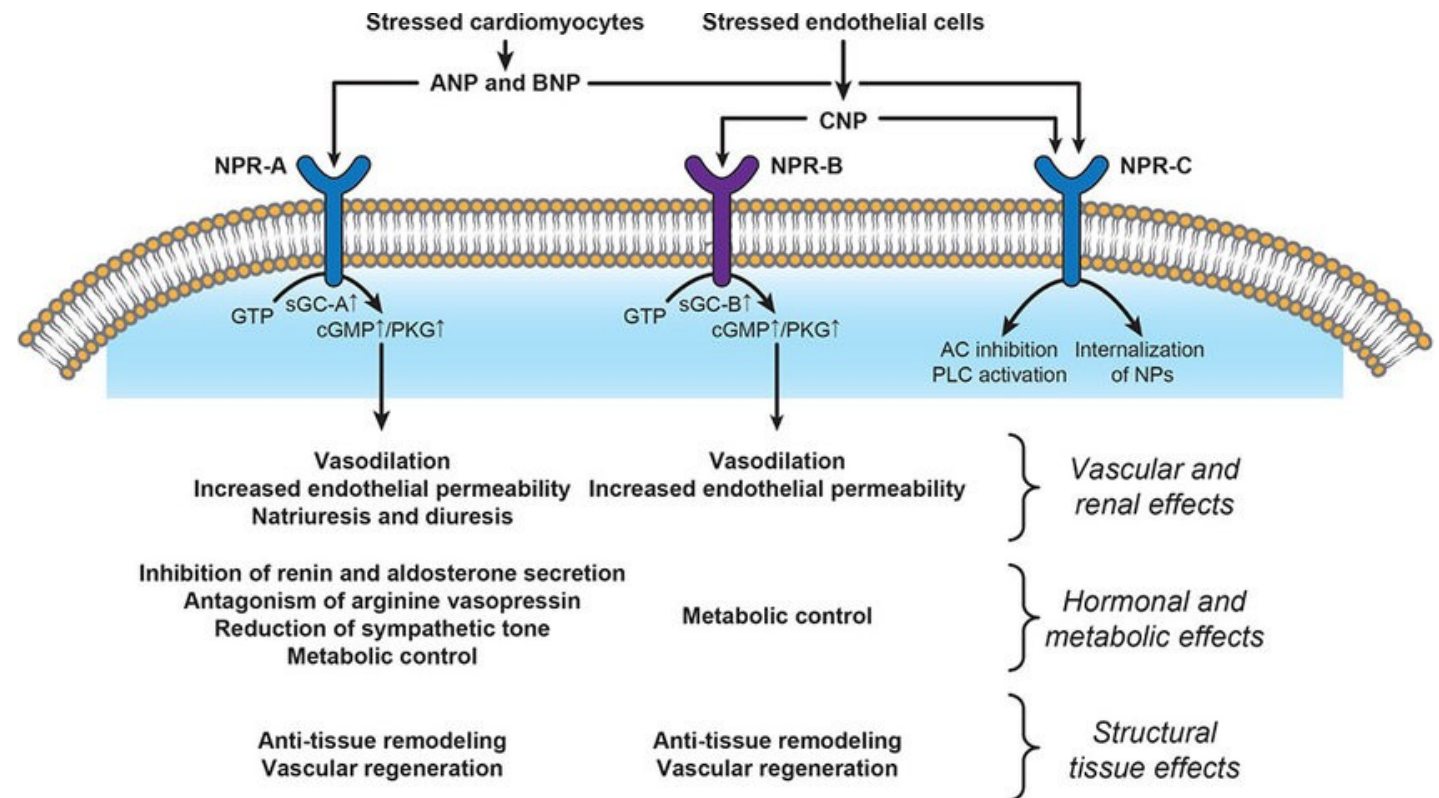
\*Myostatin:  
produced and released by myocytes  
acts on muscle cells to inhibit muscle growth  
require relatively large amounts of E/nutrients

# Natriuretic peptides

- atrial natriuretic peptide (ANP)
- B-type natriuretic peptide (BNP)
- C-type natriuretic peptide (CNP)
- dendroaspis-type natriuretic peptide (DNP)
- urodilatin

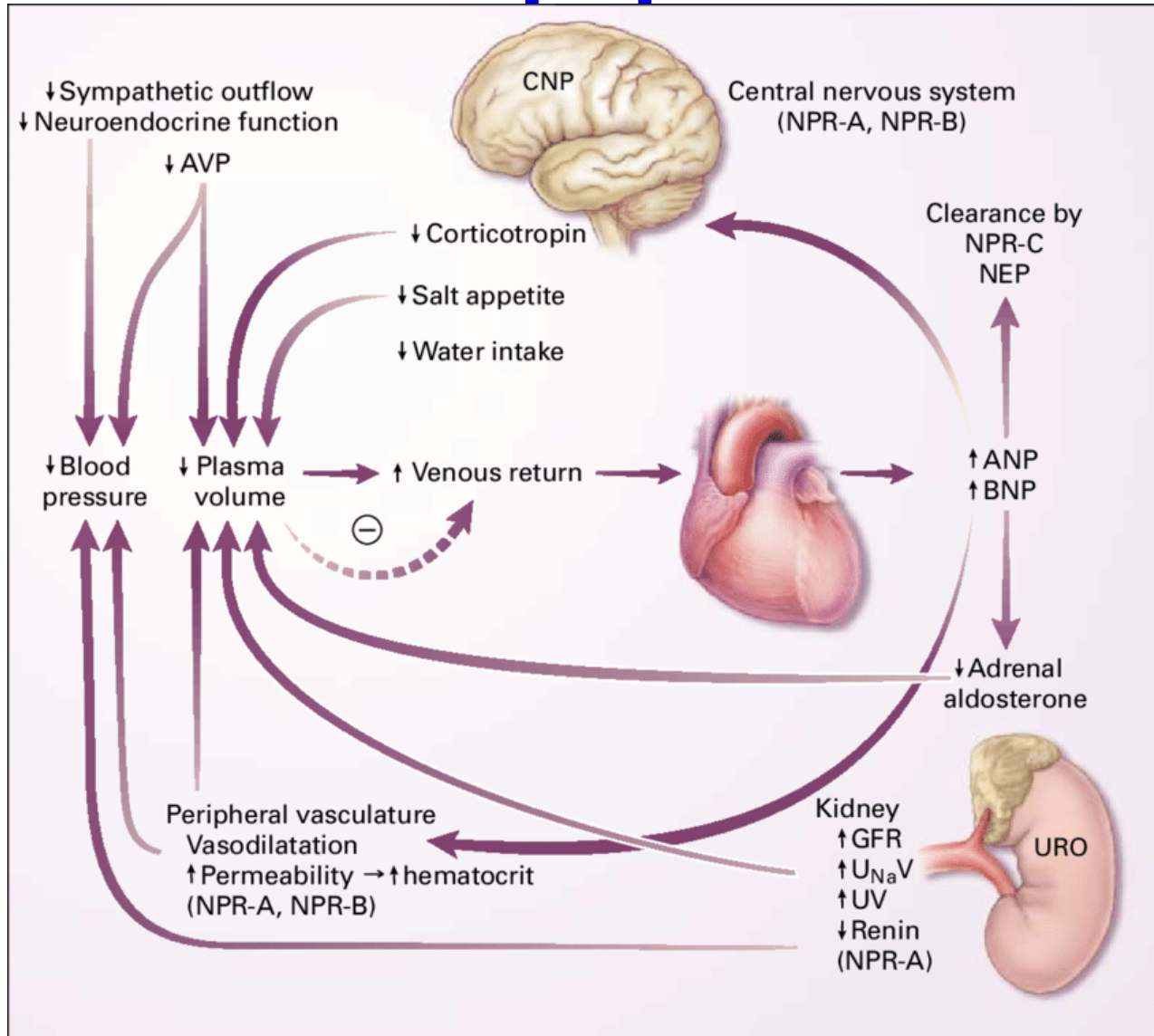


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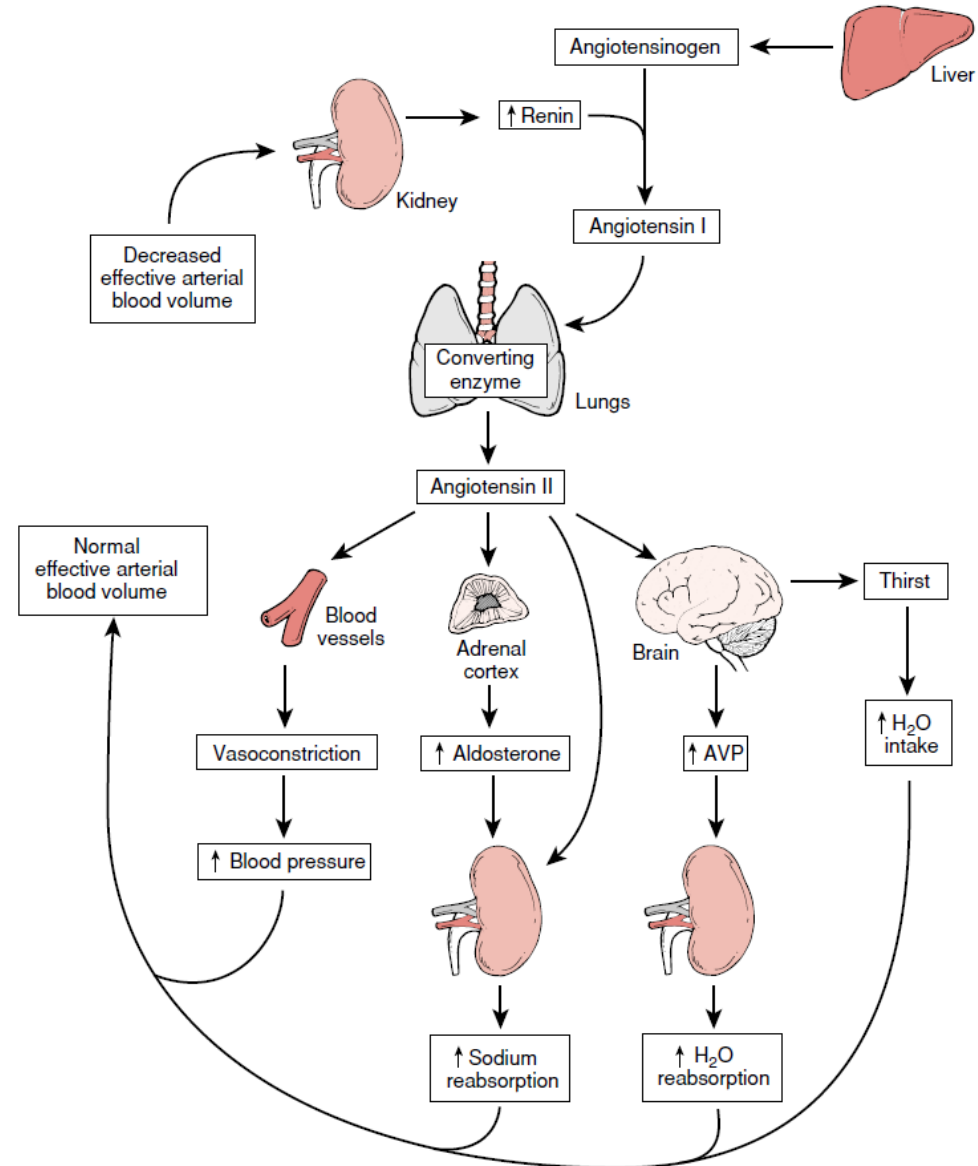


# Natriuretic peptides

$$BP = HR \times SV \times TPR$$

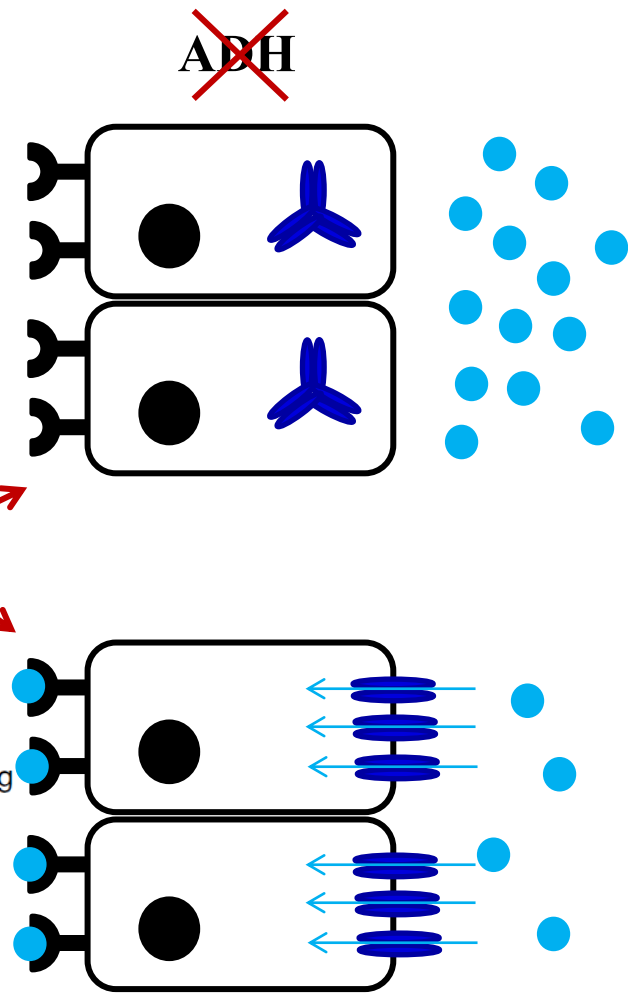
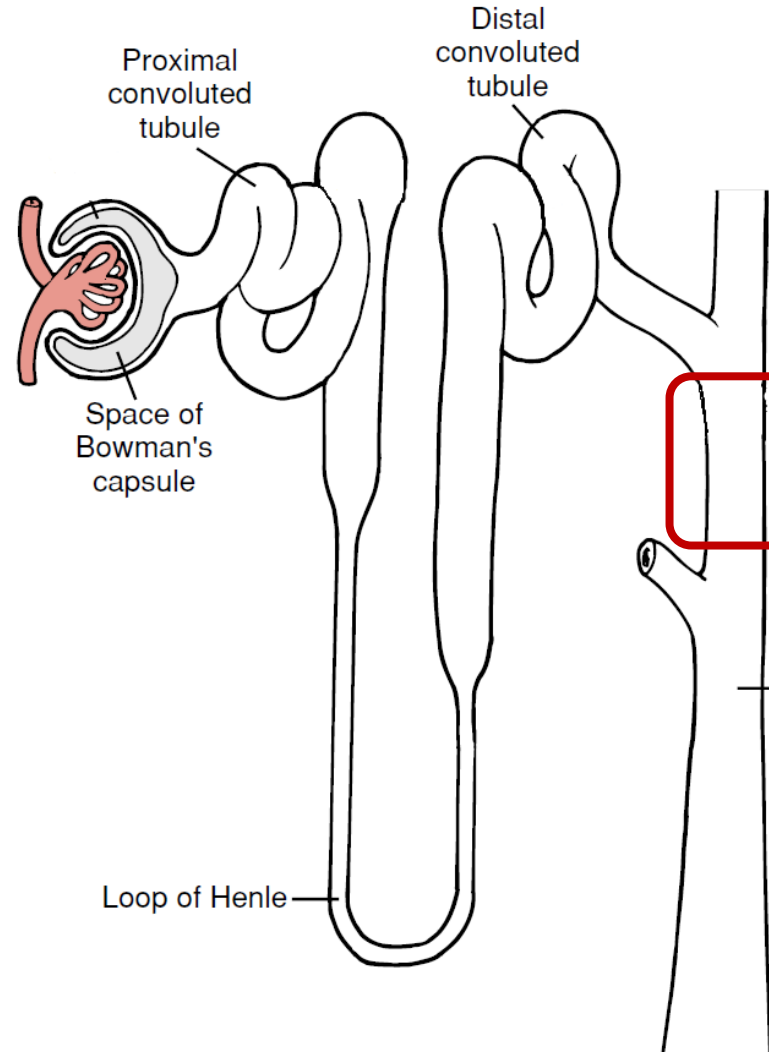
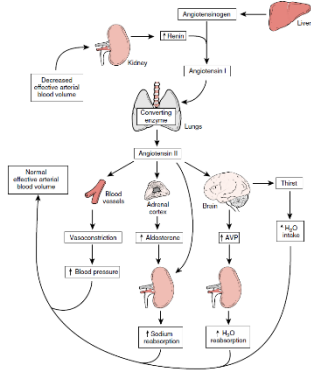


# RAAS

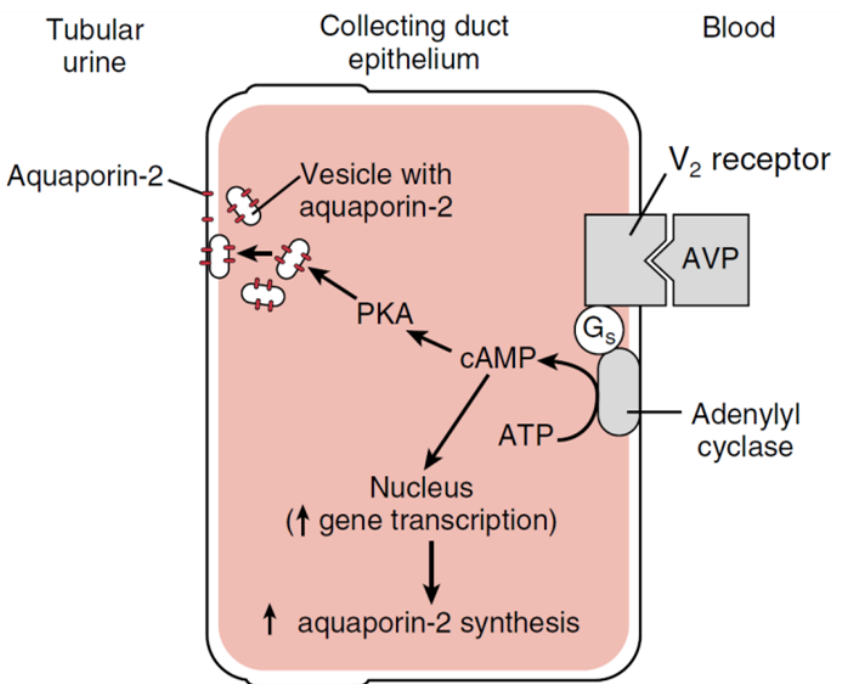




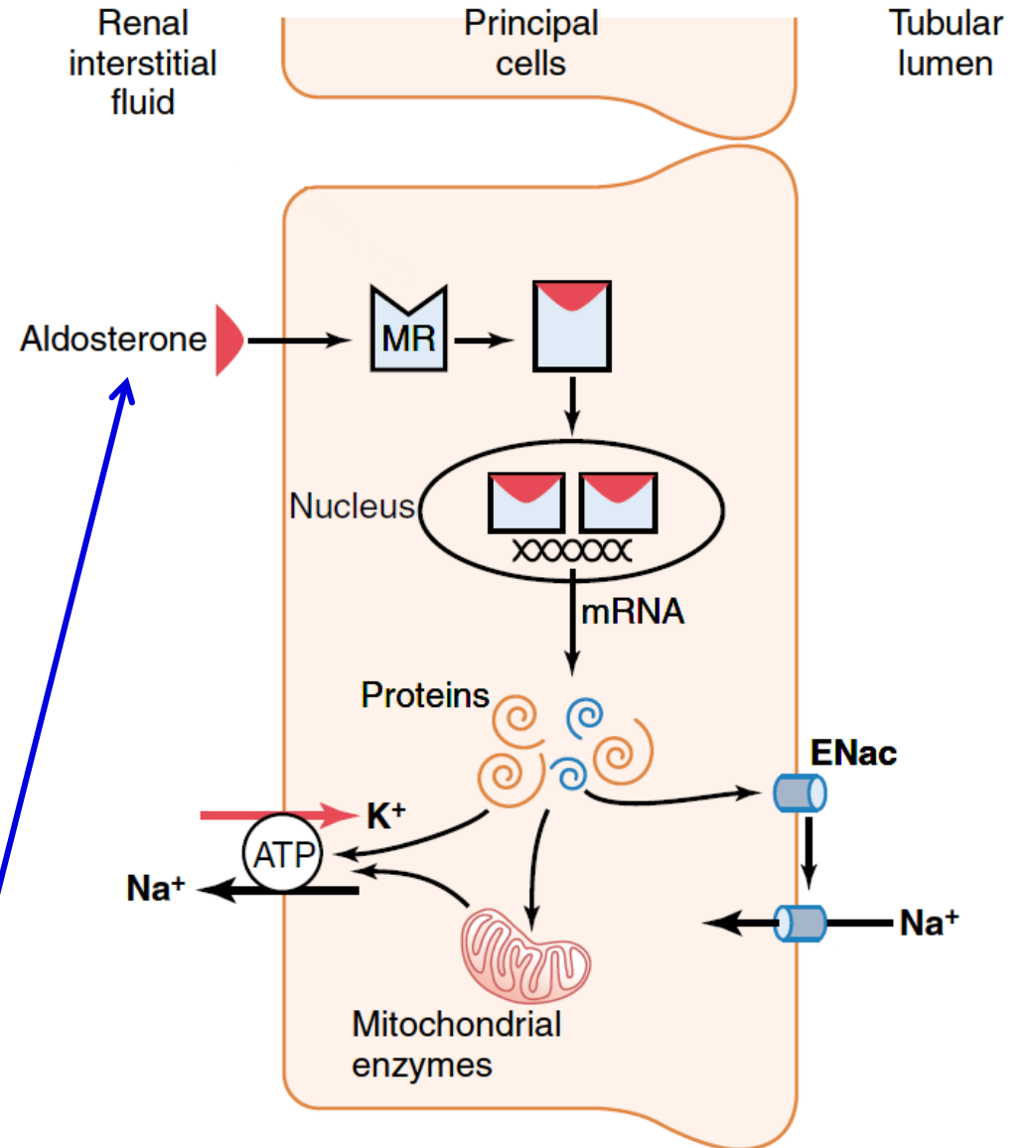
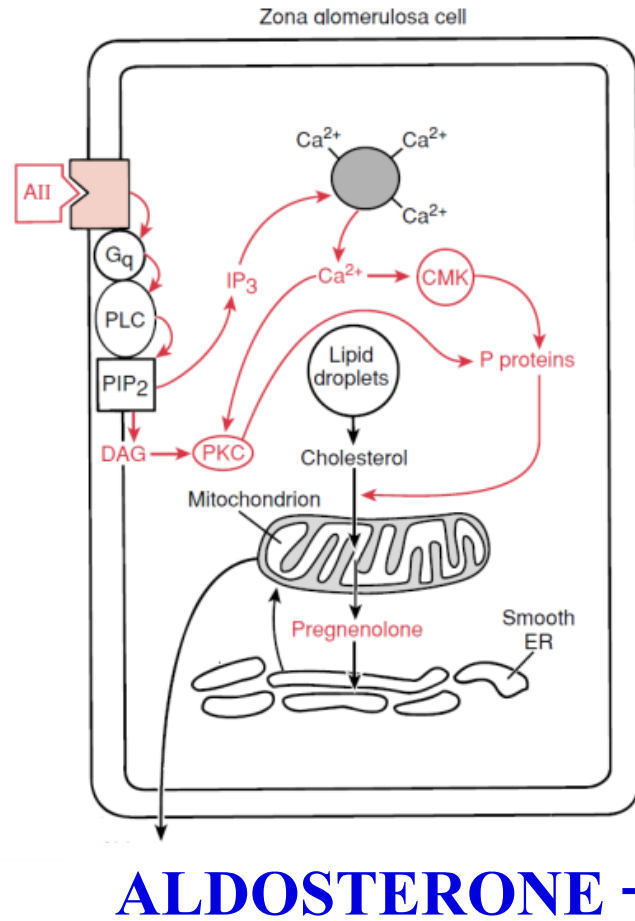
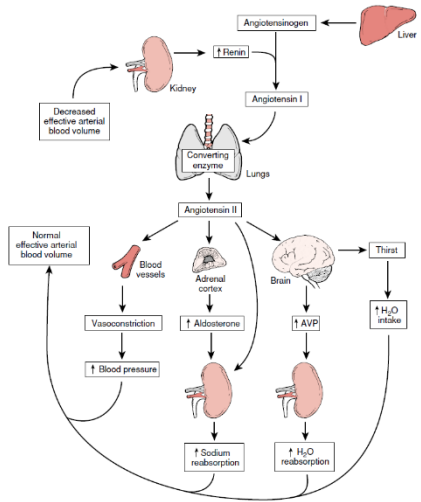
# ADH



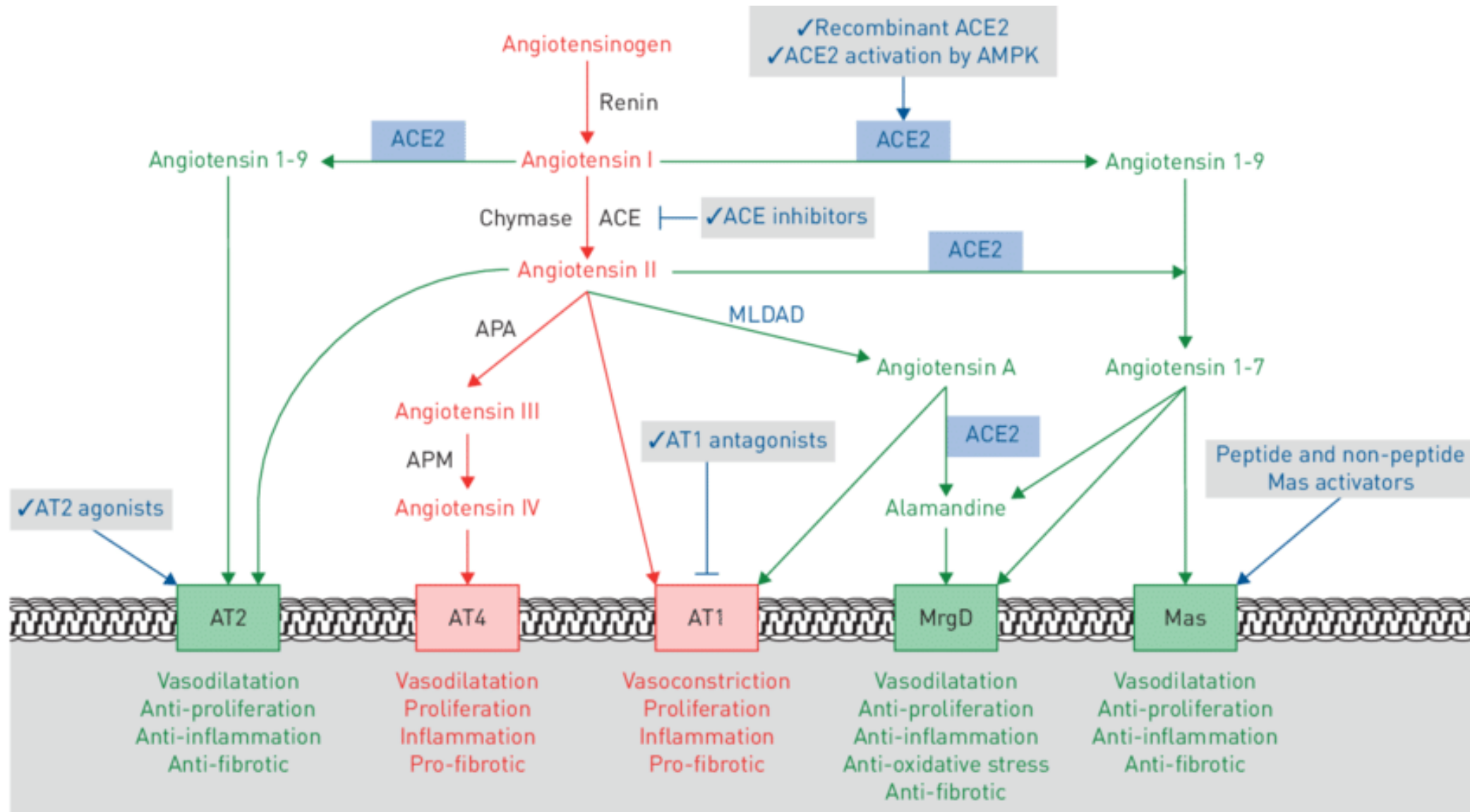
ADH  
MUNI  
MED



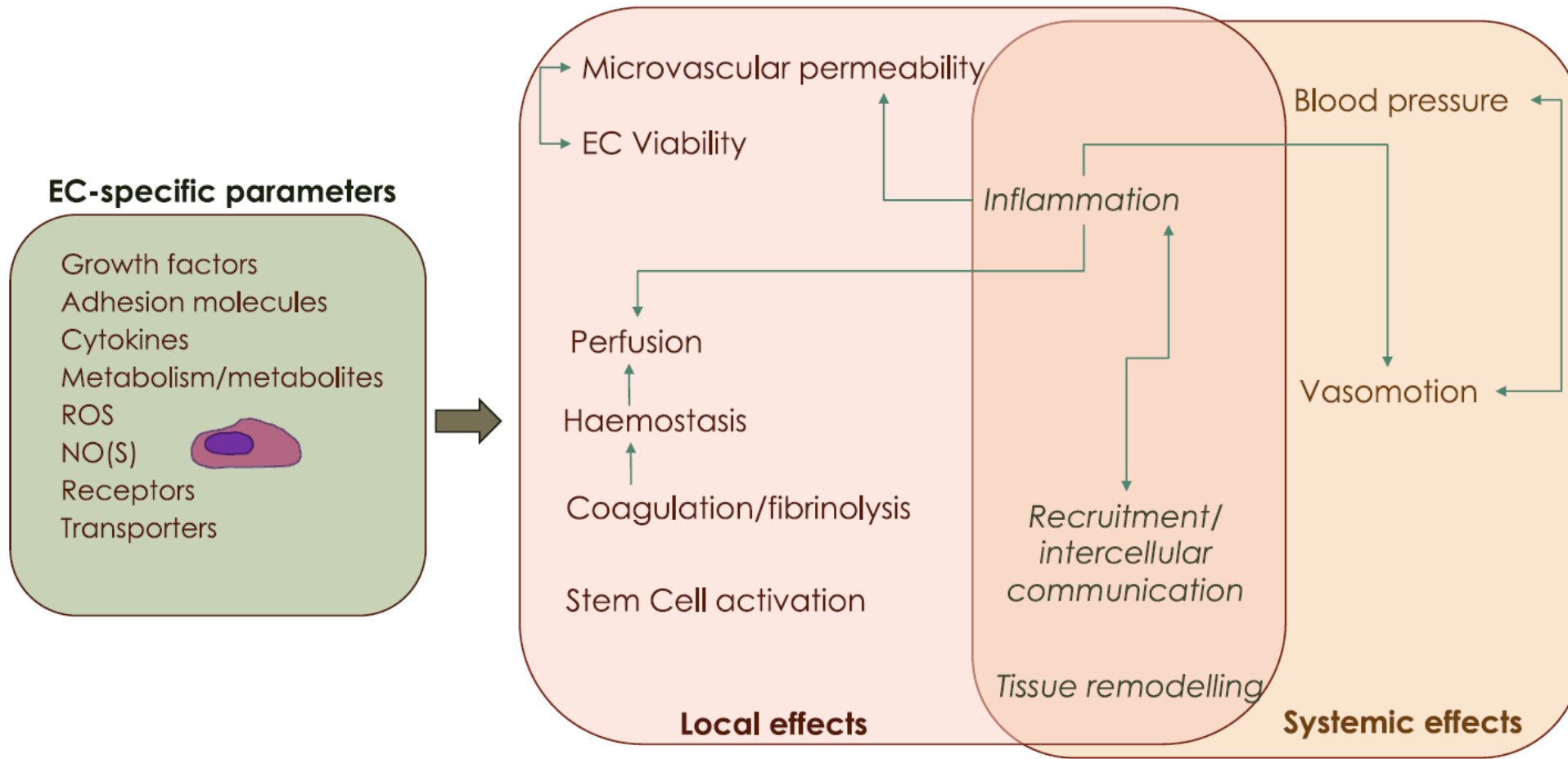
# Aldosterone



# RAAS



# Endothelial cells



# Endothelial cells

## Matrix products

fibronectin  
laminin  
collagen  
proteoglycans  
proteases

## Antithrombotic factors

prostacyclin  
thrombomodulin  
antithrombin  
plasminogen activator  
heparin

## Procoagulant factors

von Willebrand factor  
thromboxane A2  
thromboplastin  
factor V  
platelet activating factor  
plasminogen activator inhibitor

## Growth factors

insulin like growth factor  
transforming growth factor  
colony stimulating factor

## Vasodilator factors

nitric oxide  
prostacyclin

## Vasoconstricting factors

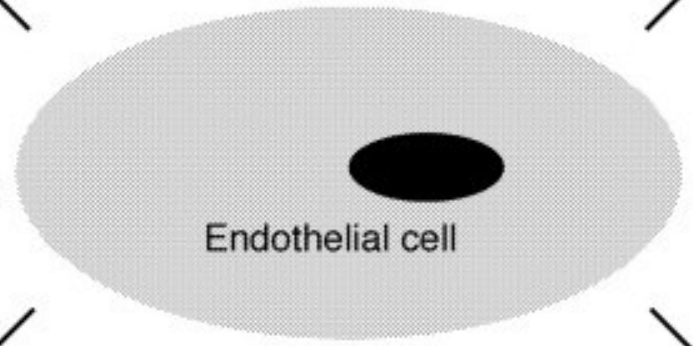
angiotensin converting enzyme  
thromboxane A2  
leukotrienes  
free radicals  
endothelin

## Inflammatory mediators

interleukins 1, 6, 8  
leukotrienes  
MHC II

## Lipid metabolism

LDL-receptor  
lipoprotein lipase

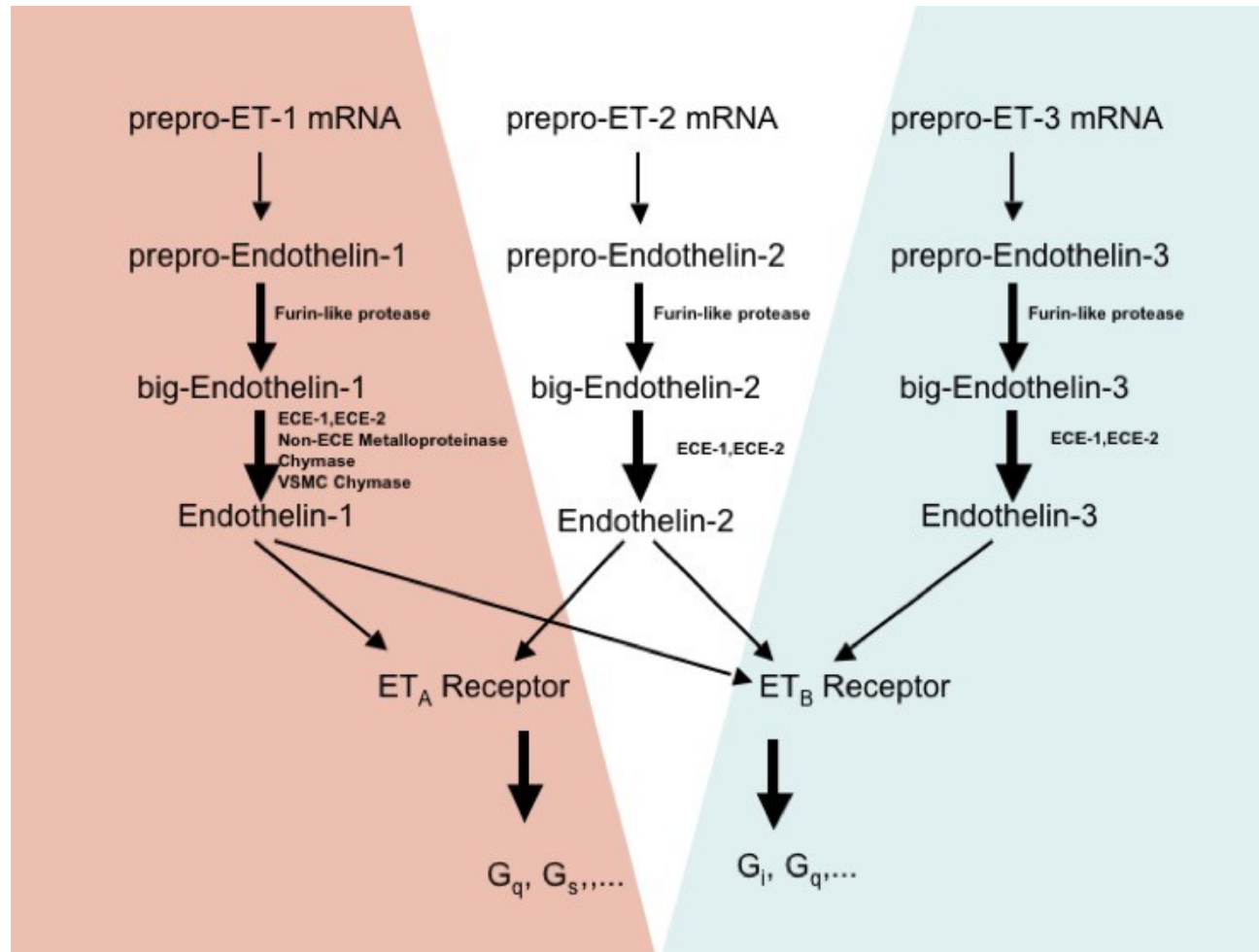


EC:

metabolic functions

synthetic functions

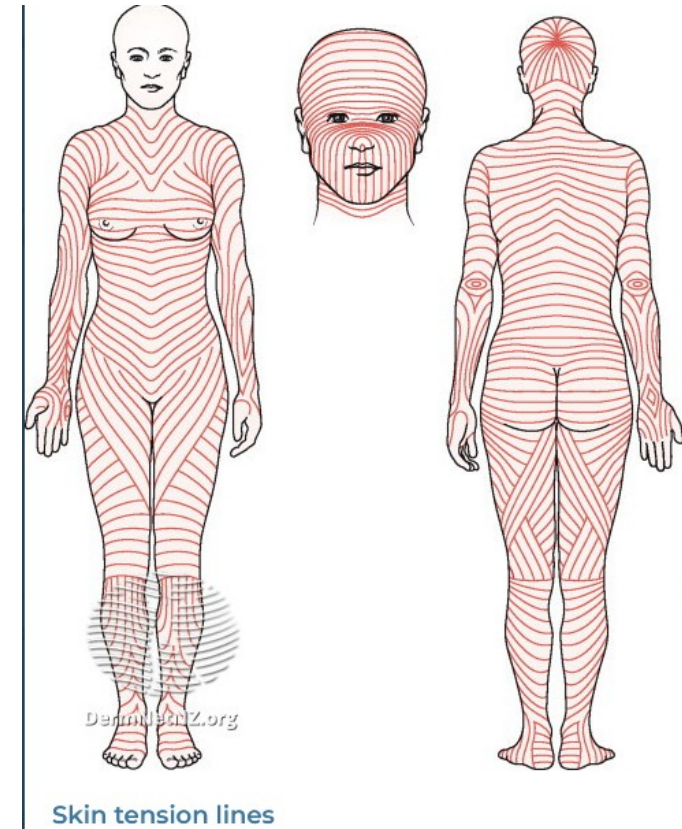
# Endothelins and their receptors



- ET<sub>A</sub>R – vasoconstriction
- ET<sub>B</sub>R – vasodilation

# Skin physiology

- skin pH and skin integrity
  - 4.1–5.8
  - pigmentation, age, localization and skin layer
- microbiome
- mechanical barrier
  - collagen
  - elastin
  - filaggrin
- immune barrier
  - Langerhans cells, T lymphocytes, granulocytes, keratinocytes, fibroblasts and melanocytes, skin associated lymphoid tissue
- thermoregulation
- photoprotection
- endocrine function



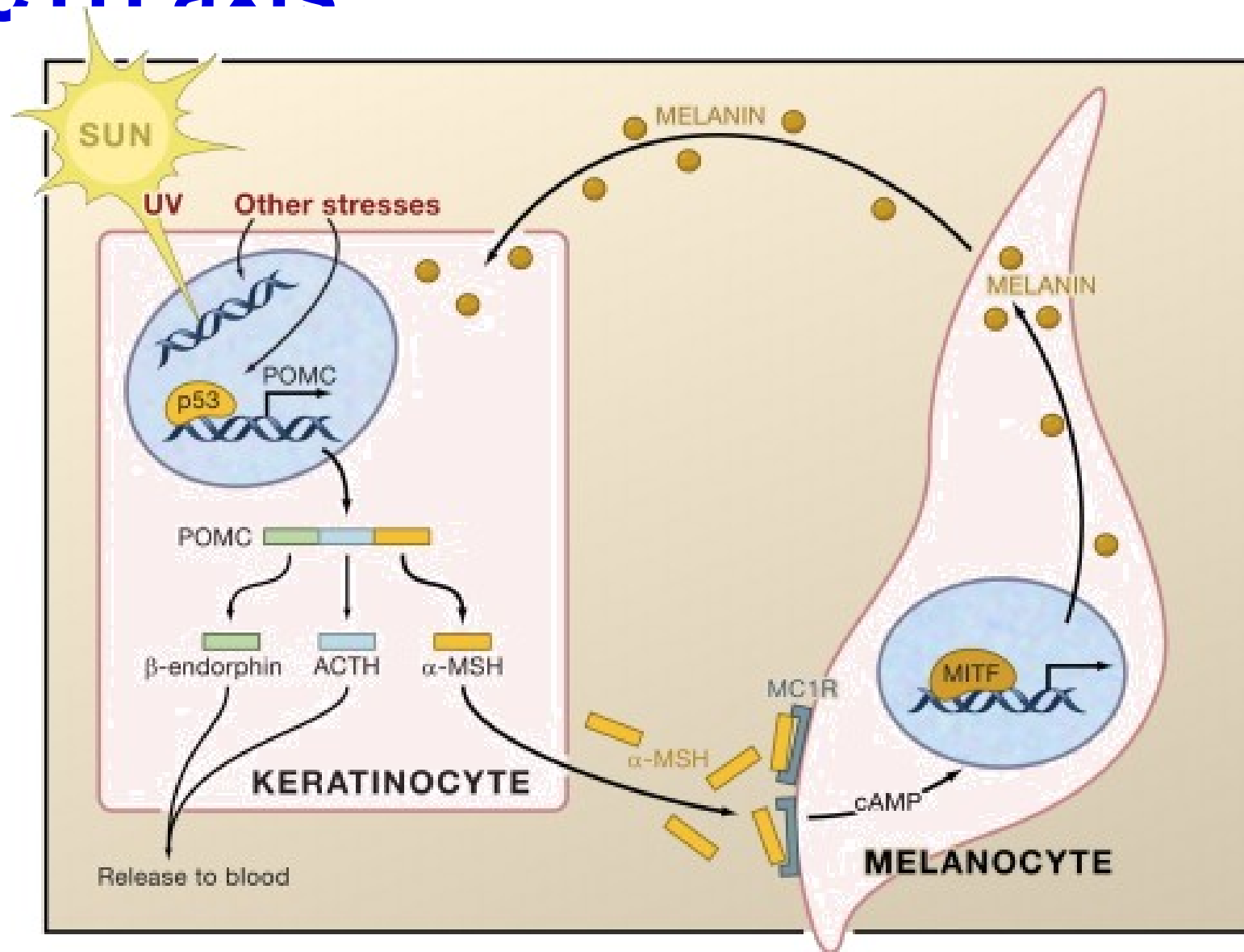
# Endocrine function of skin

Parathyroid hormone-related peptide		Keratinocytes
Corticotrophin-releasing hormone		Sebocytes, follicular keratinocytes, endothelial cells, dermal nerves
Urocortin		Epidermal and follicular keratinocytes, sweat glands, epidermal melanocytes, dermal smooth muscle cells and fibroblasts, endothelial cells
Pro-opiomelanocortin peptides	Adrenocorticotrophic hormone	Epidermal keratinocytes, melanocytes, outer root sheath of anagen follicles, dermal fibroblasts, endothelial cells
	Alpha-melanocyte-stimulating hormone	
	$\beta$ -Endorphin	Outer root sheath of anagen follicles, dermal fibroblasts
PRL		Dermal fibroblasts
Catecholamines (epinephrine and norepinephrine)		Keratinocytes
Insulin-like growth factor-I		Dermal fibroblasts, melanocytes, keratinocytes of stratum granulosum
Sex steroids		Sebaceous and sweat glands with intracellular activation depending on expression of enzymes
Retinoids (all-transretinoic acid)		Low amounts in keratinocytes
Vitamin D		Keratinocytes
Eicosanoids (prostaglandins, prostacyclins and leukotriene)		Keratinocytes, sebocytes

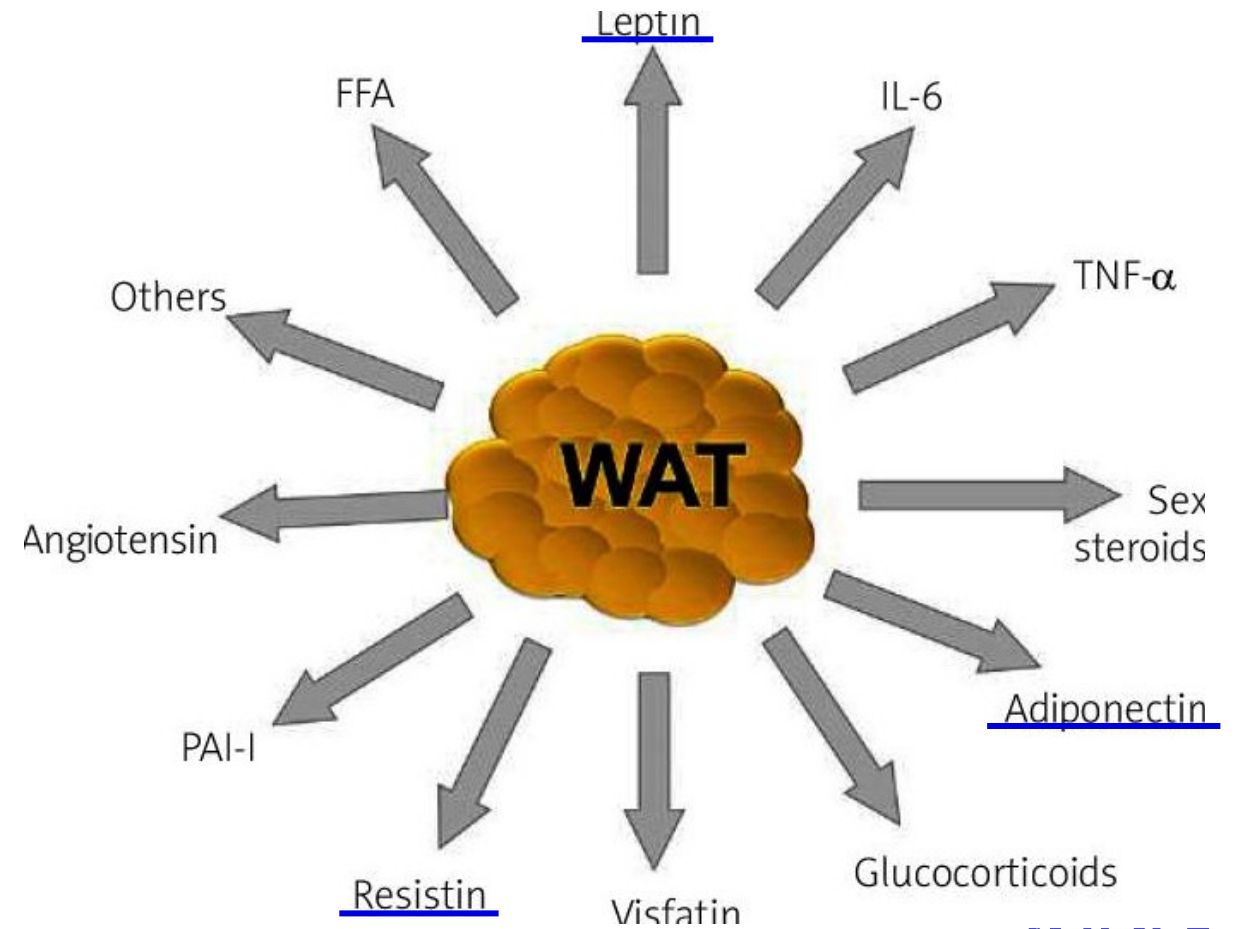
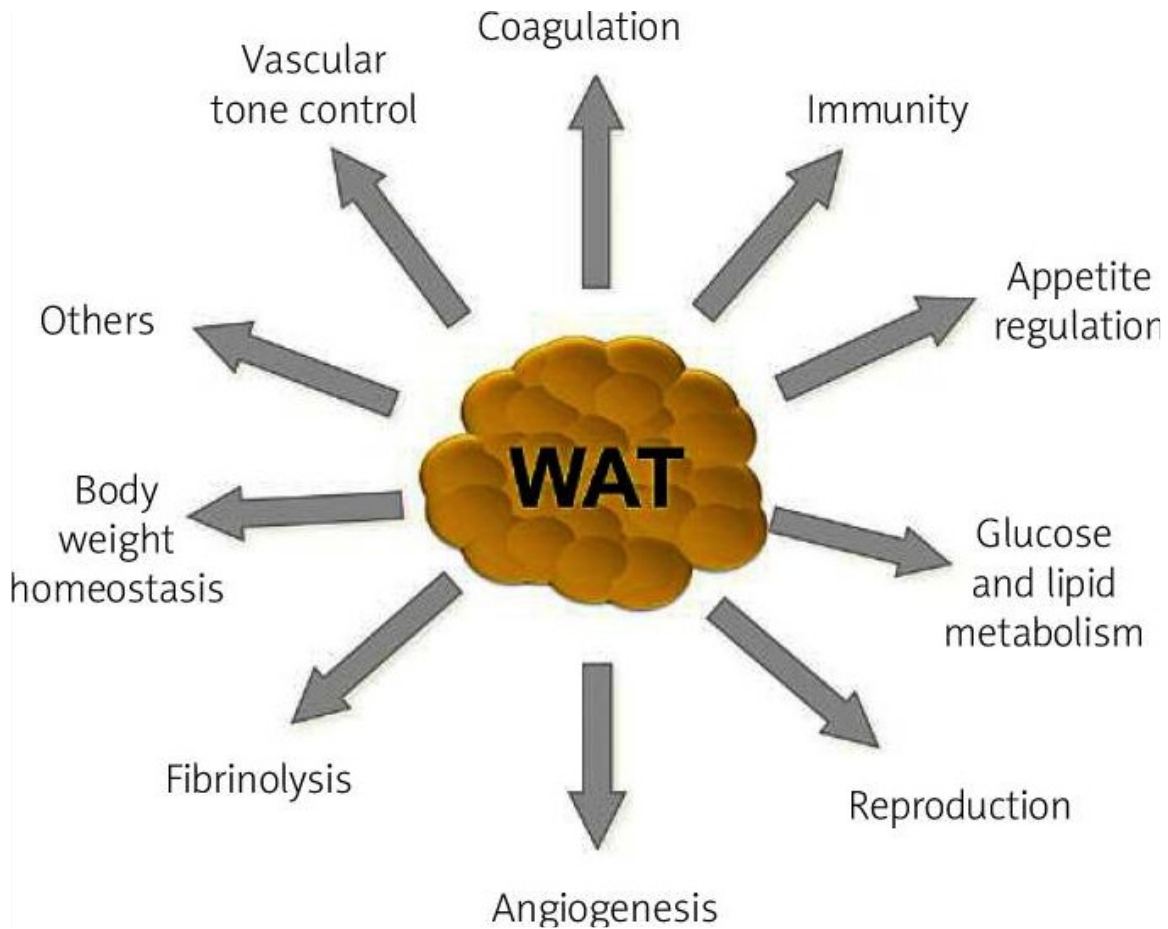


# Skin and CRH-ACTH axis

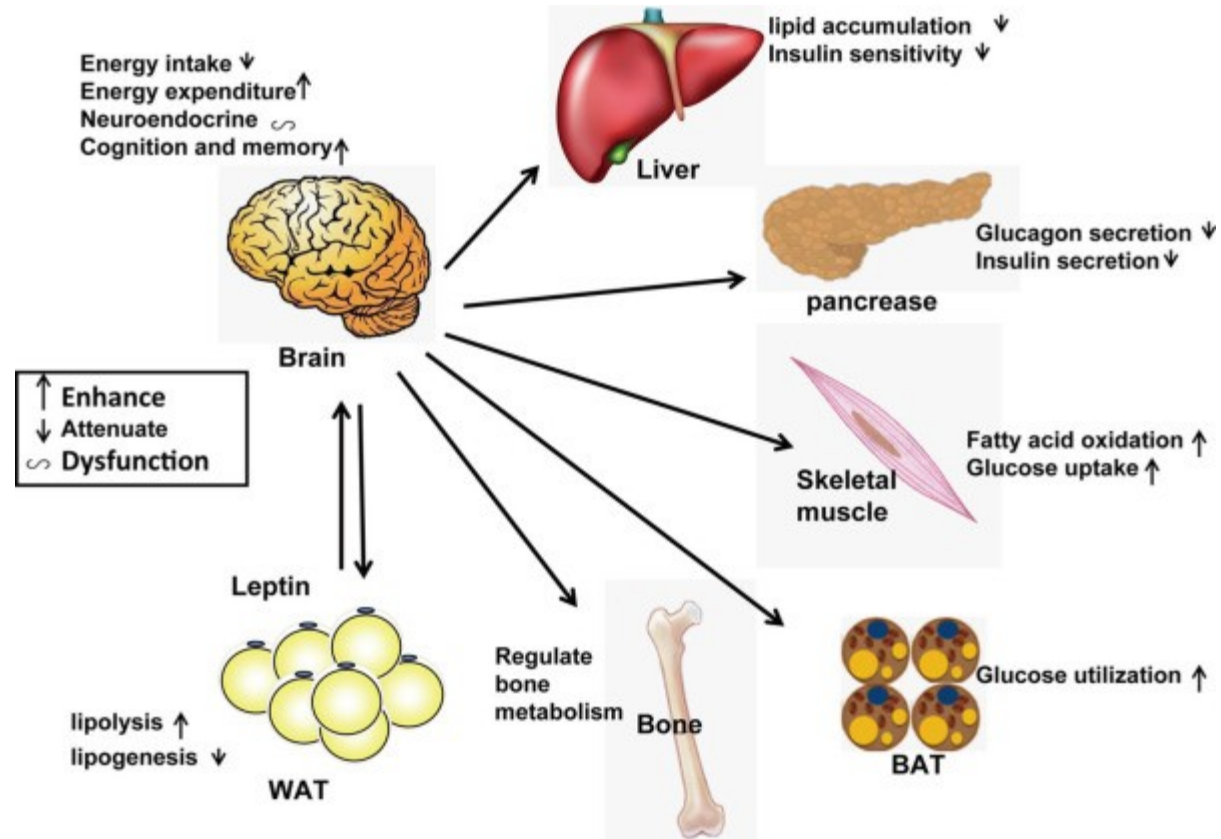
POMC  
↓  
Pro-ACTH  
↓  
ACTH



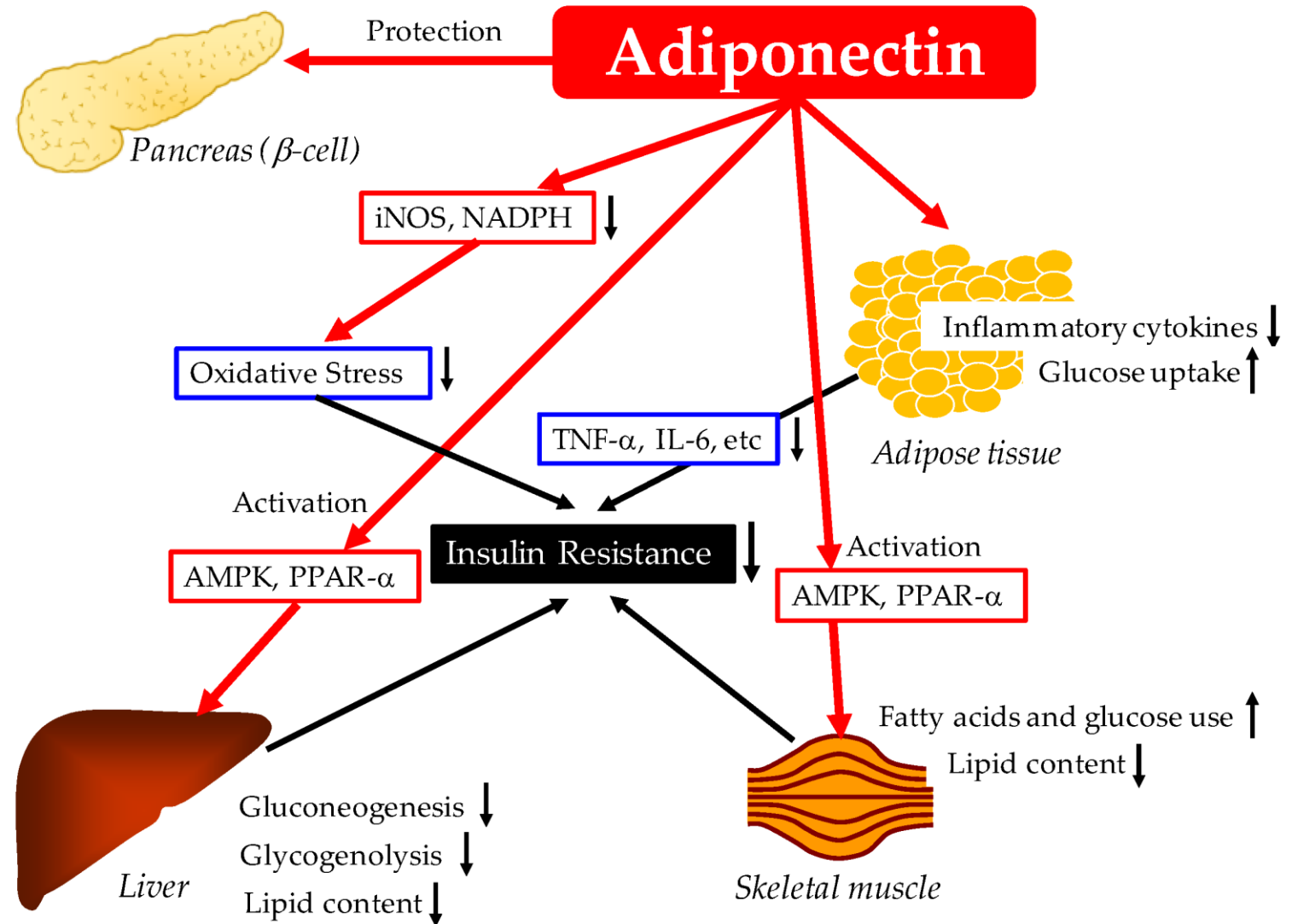
# Endocrine function of adipose tissue



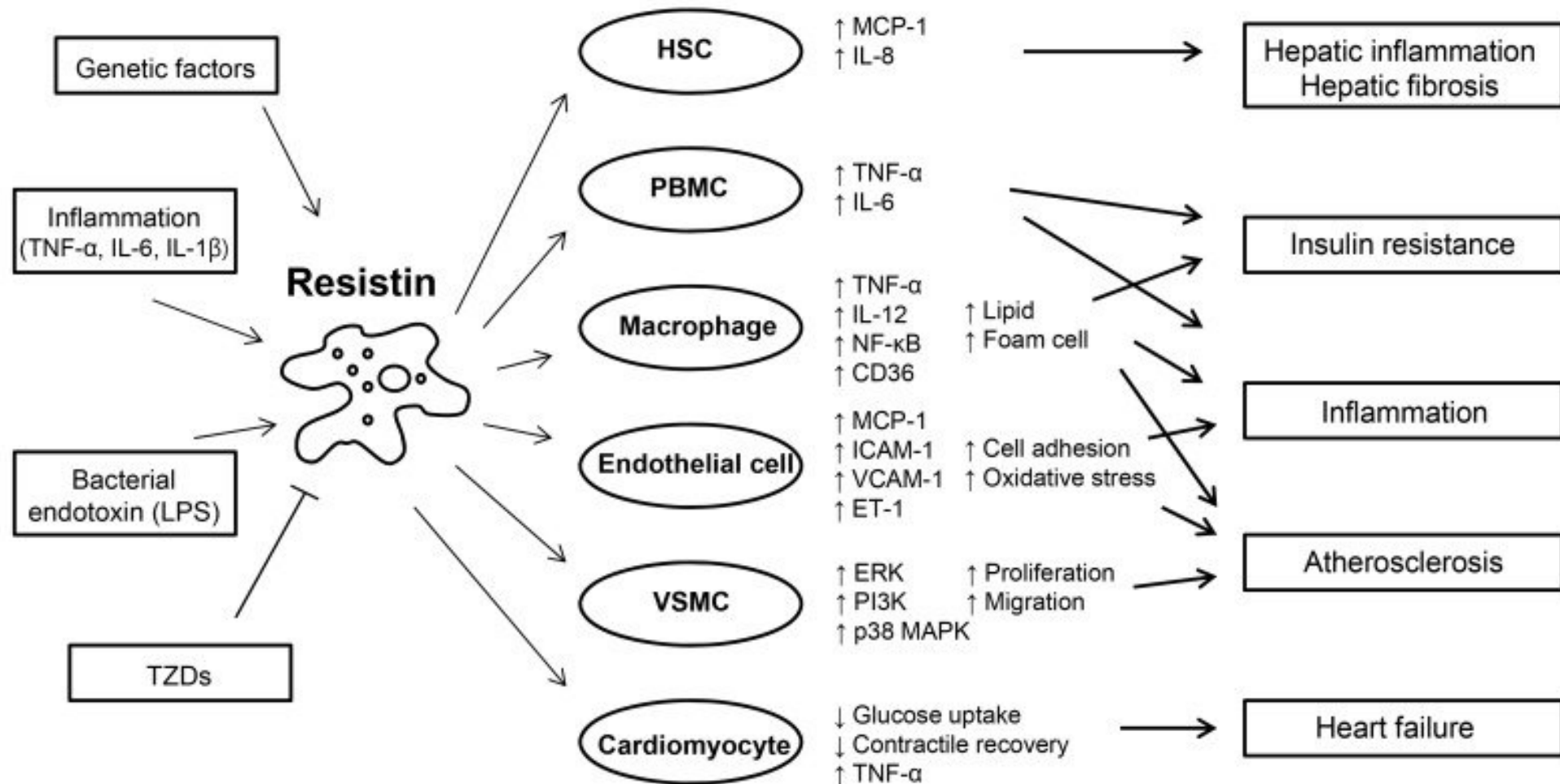
# Leptin - functions



# Adiponectin



# Resistin



**Thank you for your attention**