Aetiopathology of Hypertension

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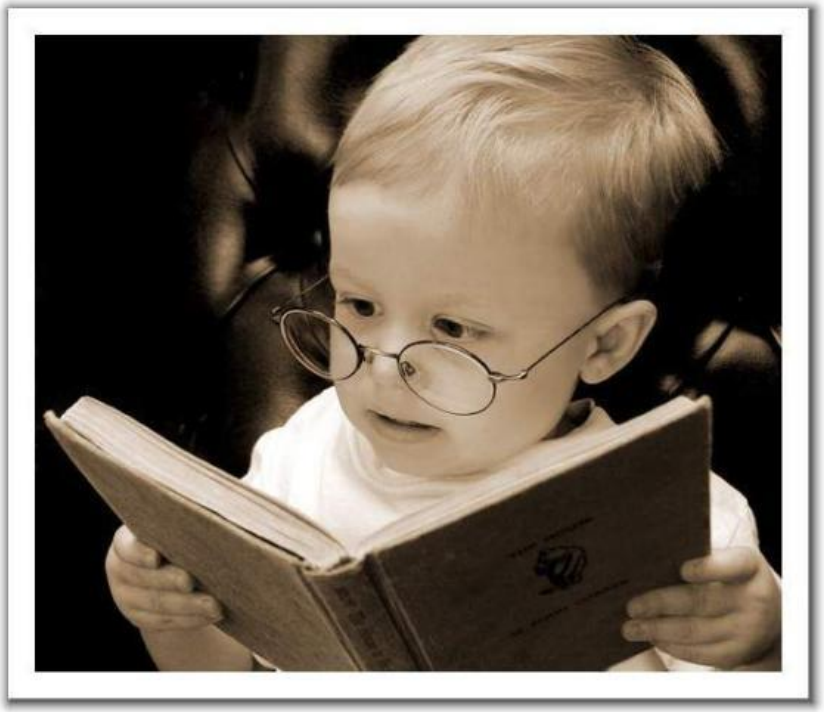


Why study HPT

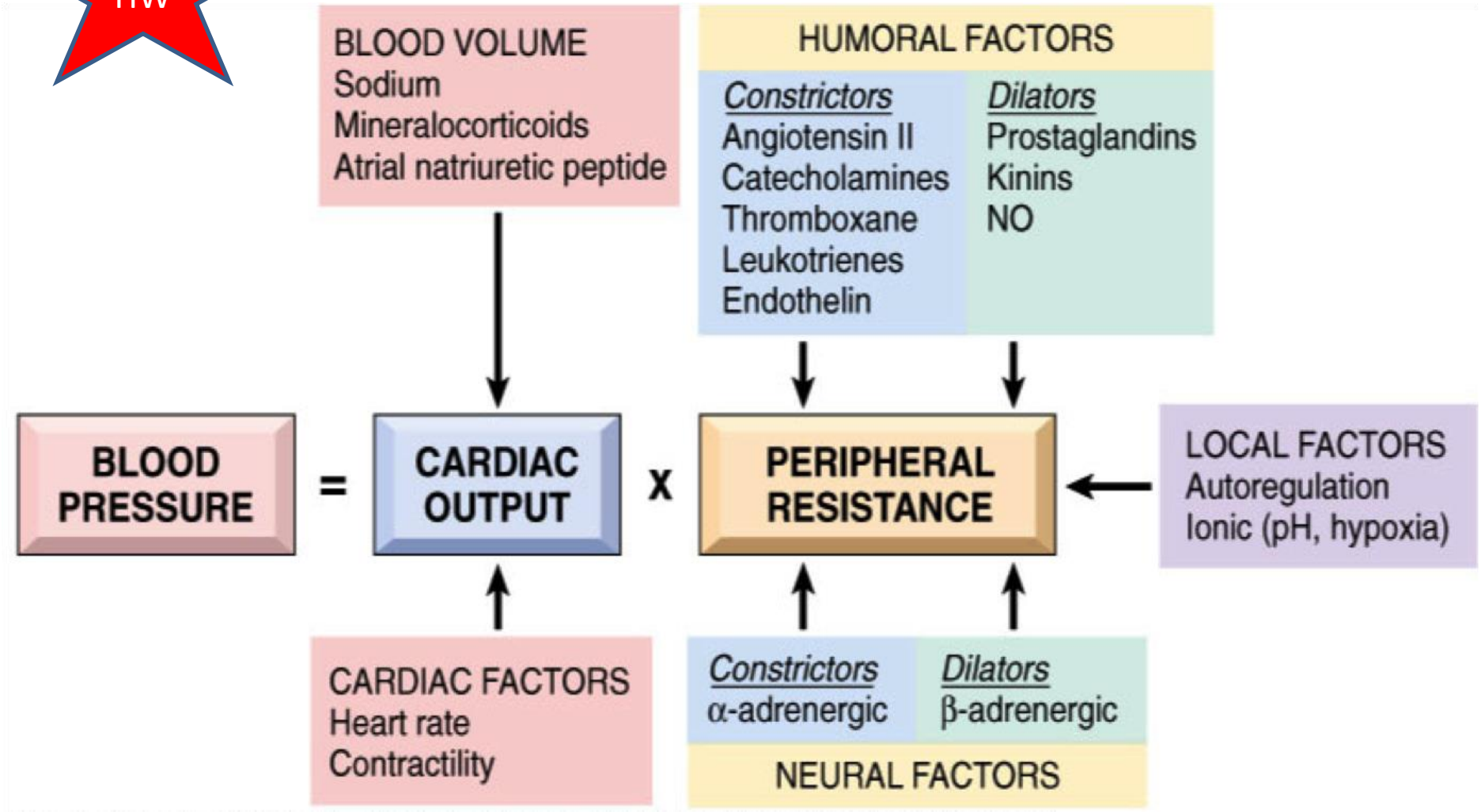
- ¼ th of the adult population has HPT
- SL-18.8%-male;19.3% female
- Morbidity & mortality
- Exam

Objectives

- Describe the regulation of normal blood pressure
- Describe the mechanism of essential hypertension
- List the causes of secondary hypertension
- Describe the pathological changes in hypertension .

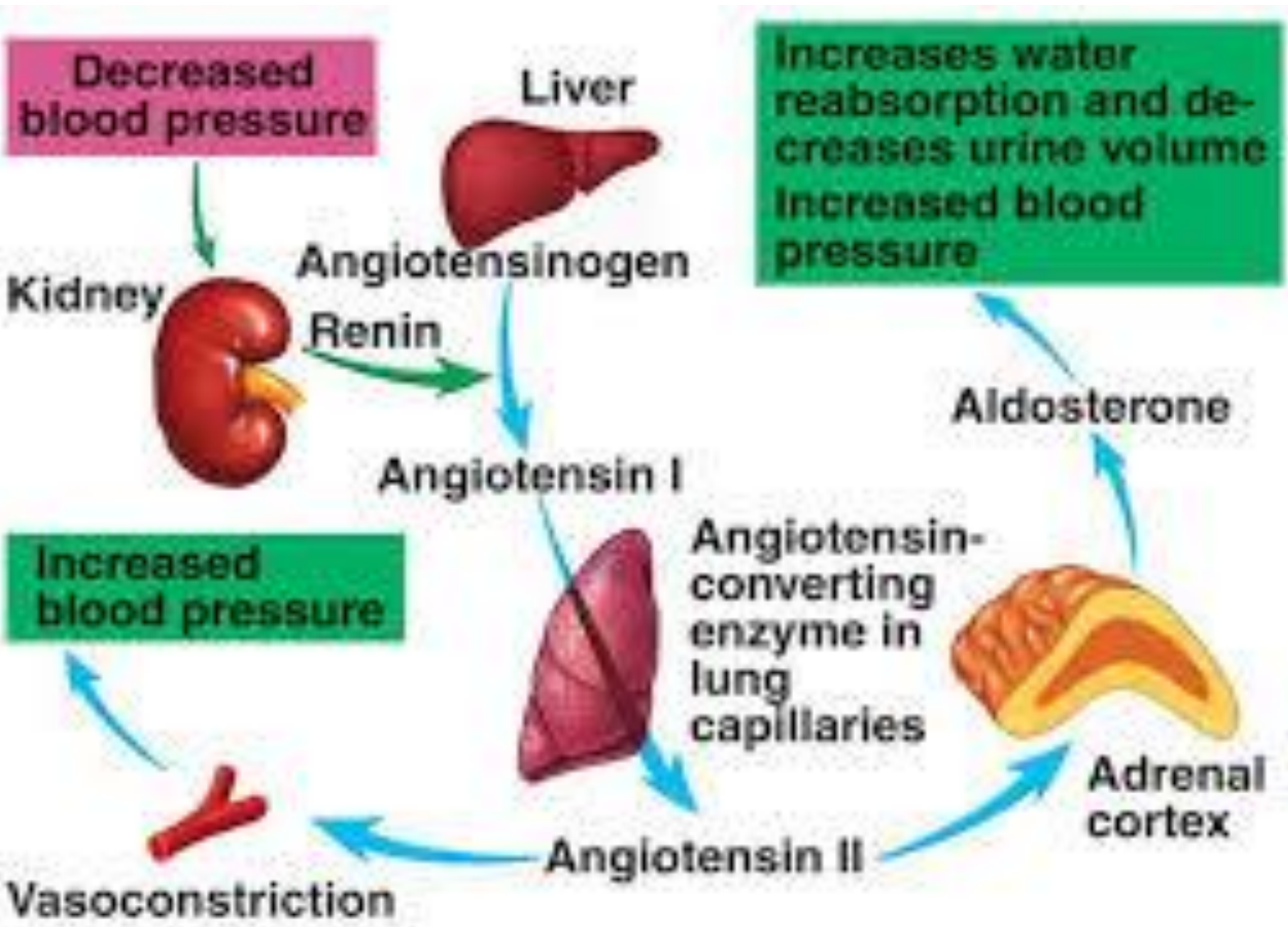
Regulation of normal blood pressure

HW



Hypertension
Mechanisms that Regulate BP

- Renal System- **Renin angiotensin system-Major role**
- Sympathetic Nervous System
- Vascular Endothelium
- Endocrine System


Decreased blood pressure
Liver
Increases water reabsorption and decreases urine volume
Increased blood pressure
Angiotensinogen
Kidney
Renin
Aldosterone
Angiotensin I
Angiotensin-converting enzyme in lung capillaries
Increased blood pressure
Adrenal cortex
Angiotensin II
Vasoconstriction

Regulation of normal blood pressure cont.

- **Endocrine System**
  - **Adrenal medulla-Catecholamines**
  - **Adrenal Cortex – Aldosterone – stimulates kidneys to retain Na+**
  - **Increased Na+ stimulates posterior pituitary – ADH – reabsorbs ECF/water**

Regulation of normal blood pressure cont.

- Vasorelaxants produced by kidneys

  NO , PG

- Other organs that contribute

  Volume expansion in atria

  ↓

  Atrial natriuretic peptide (endogenous inhibitor of RA system)

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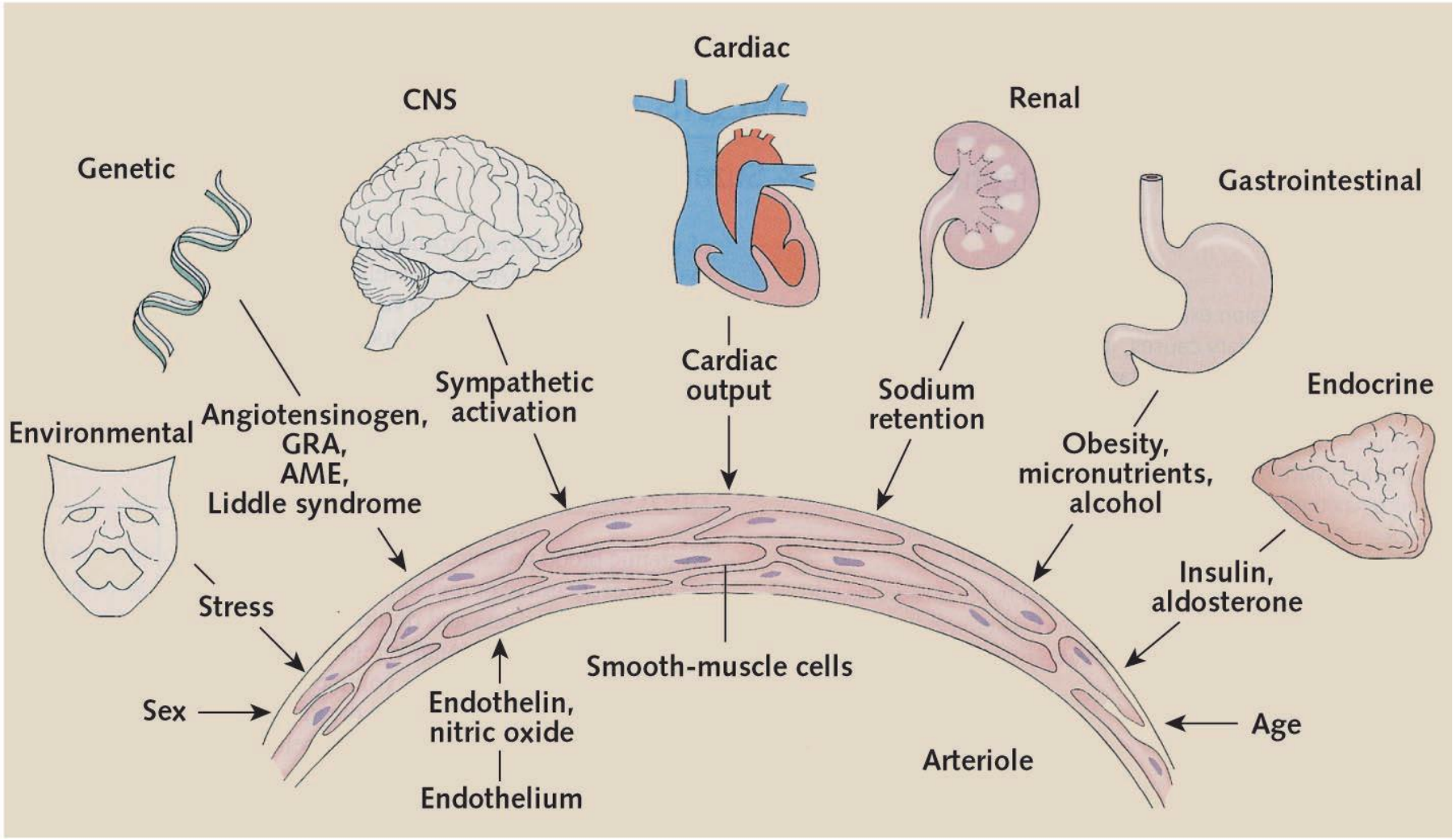
  Inhibit Na absorption in DCT ⟶ diuresis

  Vadsodilatation

Pathophysiologic mechanisms of hypertension.



AME apparent mineralocorticoid excess; CNS central nervous system; GRA glucocorticoid-remediable aldosteronism.

Hypertension

1)Essential (Primary , Idiopathic) (90-95%)

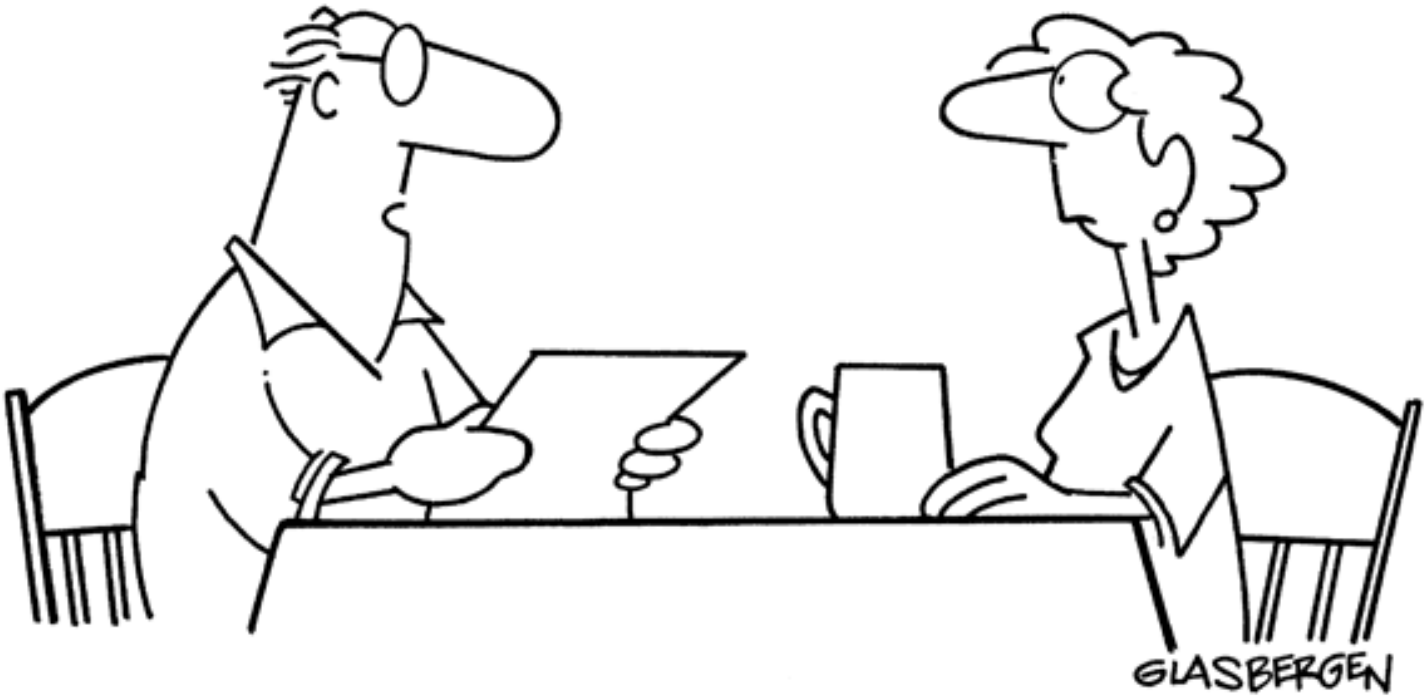
2) Secondary hypertension (5-10%)

Benign vs accelerated/malignant hypertension

Malignant Hypertension

- Severe HPT
- Rapidly rising
- SBP>200mmhg;DBP>120mmhg
- Renal failuure
- Retinal haemorrhages & exudates
- +/- papilledema
- If untreated death within a short time

Causes of secondary hypertension



"My blood pressure is 180/90 which mathematically is equal to 2/1 which doesn't seem so high!"

Causes of secondary hypertension

MCQ

1)Renal diseases (3-4%)

a) Renal vascular diseases - ↑ ***Renin secretion***

(Narrowing of arteries activate the renin- angiotensin system.)

Renal artery stenosis (Atheroma , fibromuscular dysplasia)

Arteritis

Renal artery embolism

b) Renal parenchymal diseases -↑ ***Na retention***

Acute GN

Chronic GN

Chronic pyelonephritis

Polycystic kidney diseases

c) Renal neoplasm - ***renin secretion***

Causes of secondary hypertension cont.

2)Endocrine causes (1%)

Pheochromocytoma - Catecholamines

Primary aldosteronism - Aldosterone

(Conn's syndrome)

Cushings syndrome - Cortisol excess

Acromegaly

Thyroid dysfunction

3) Coarctation of aorta - ↑ Renin secretion

4) Drug induced

5) Pregnancy induced

Objectives

- Describe the regulation of normal blood pressure
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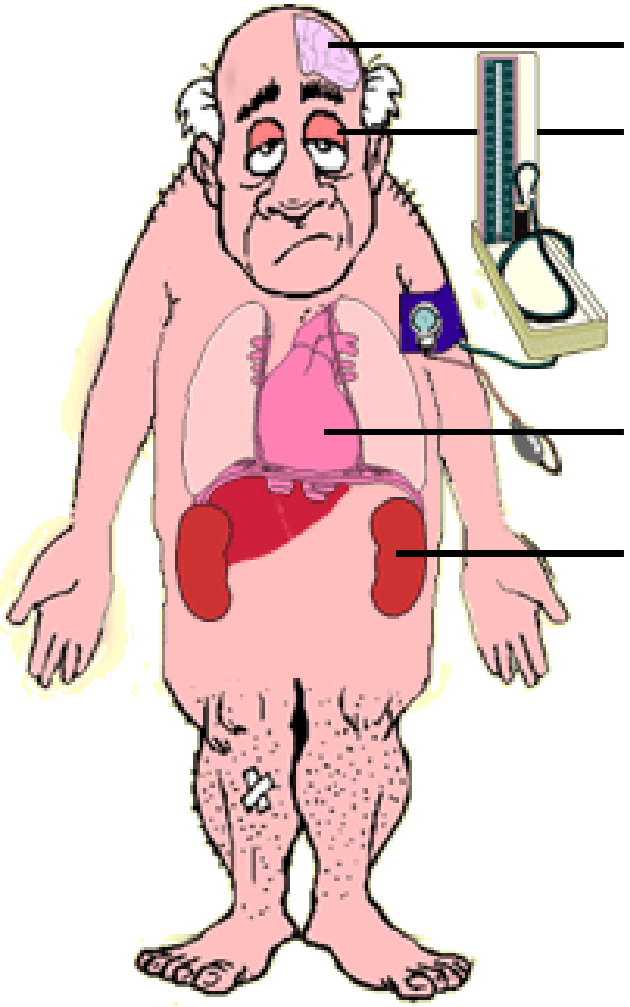
Pathlogical changes

1)Blood vessels

2)Heart

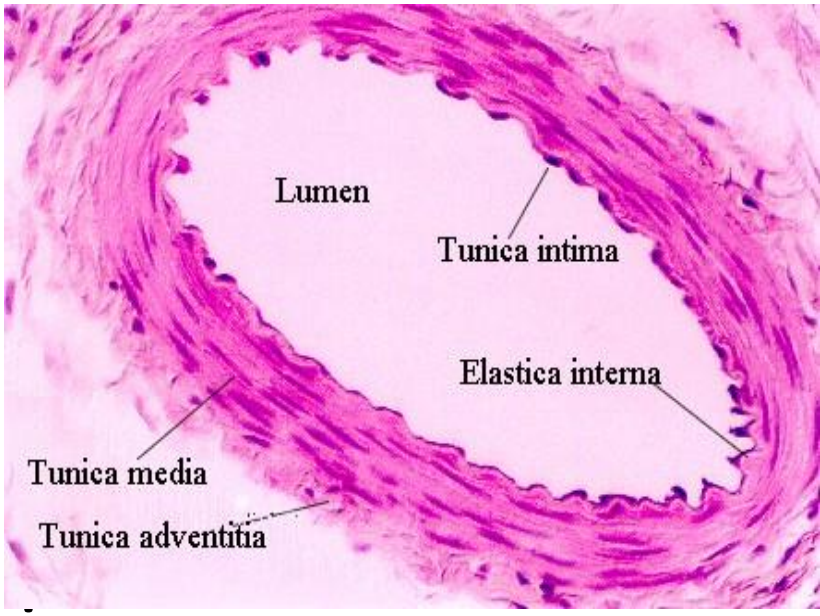
3)Kidney

4)Brain



1.Blood vessels

1.Large & medium 2.Small



1.Large & medium sized arteries

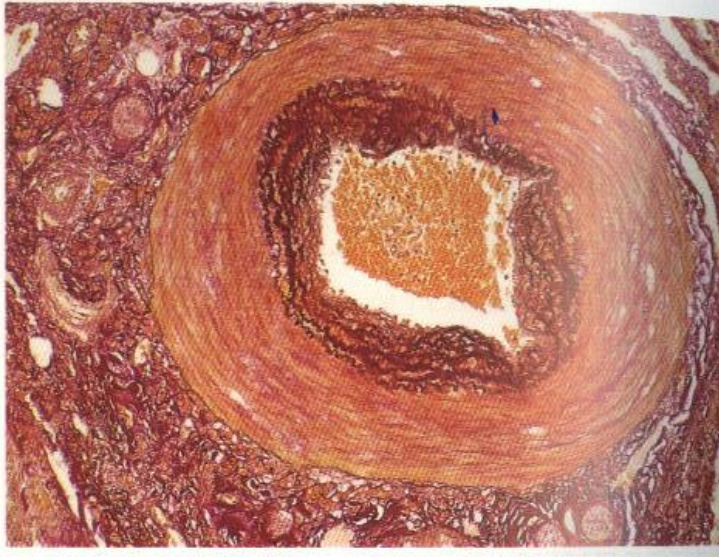
Medial hypertrophy

↑ atherosclerosis

degenerative changes in the media

Risk: aortic dissection/CNS bleeding

Hypertrophy of the media



- Causes thickening of the vessel

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- Narrowing of the vessel lumen

- This increases the response to stimuli (vascular amplifier)

2.Small vessels

- **Hyaline arteriolosclerosis**
- **Hyperplastic arteriolosclerosis**
- Necrotizing arteriolitis

Hyaline arteriolosclerosis

- In benign hypertension
- Also in elderly and diabetic patients
- Affects small arteries and arterioles
- Thickening of the vascular wall due to deposition of a homogenous pink hyaline material

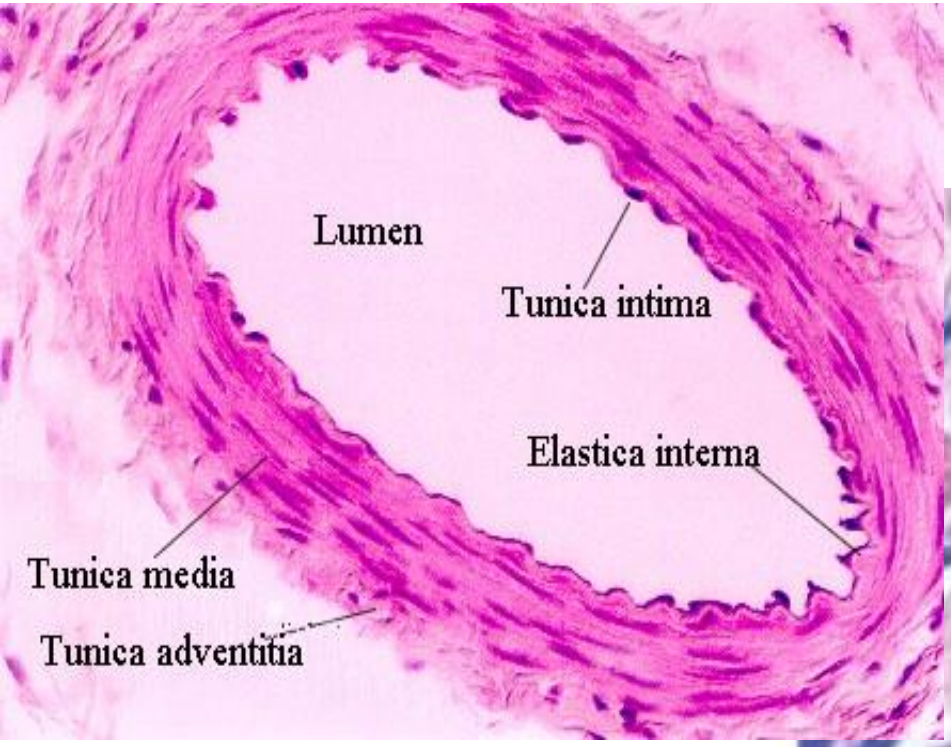
↓

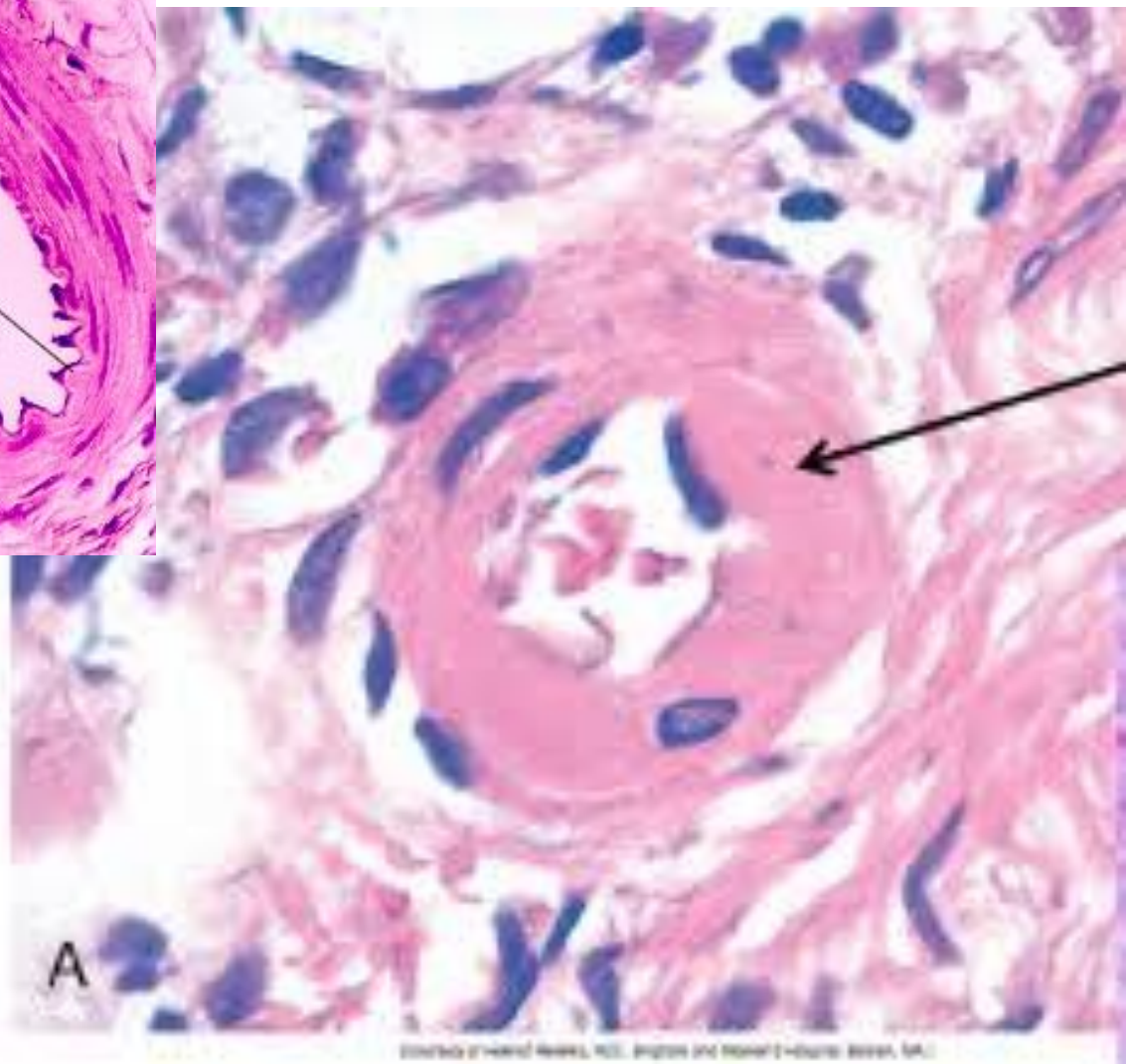
narrowing of vascular lumina

Occurs due to leakage of plasma protein &

EC matrix production by SMC

Hyaline arteriolosclerosis

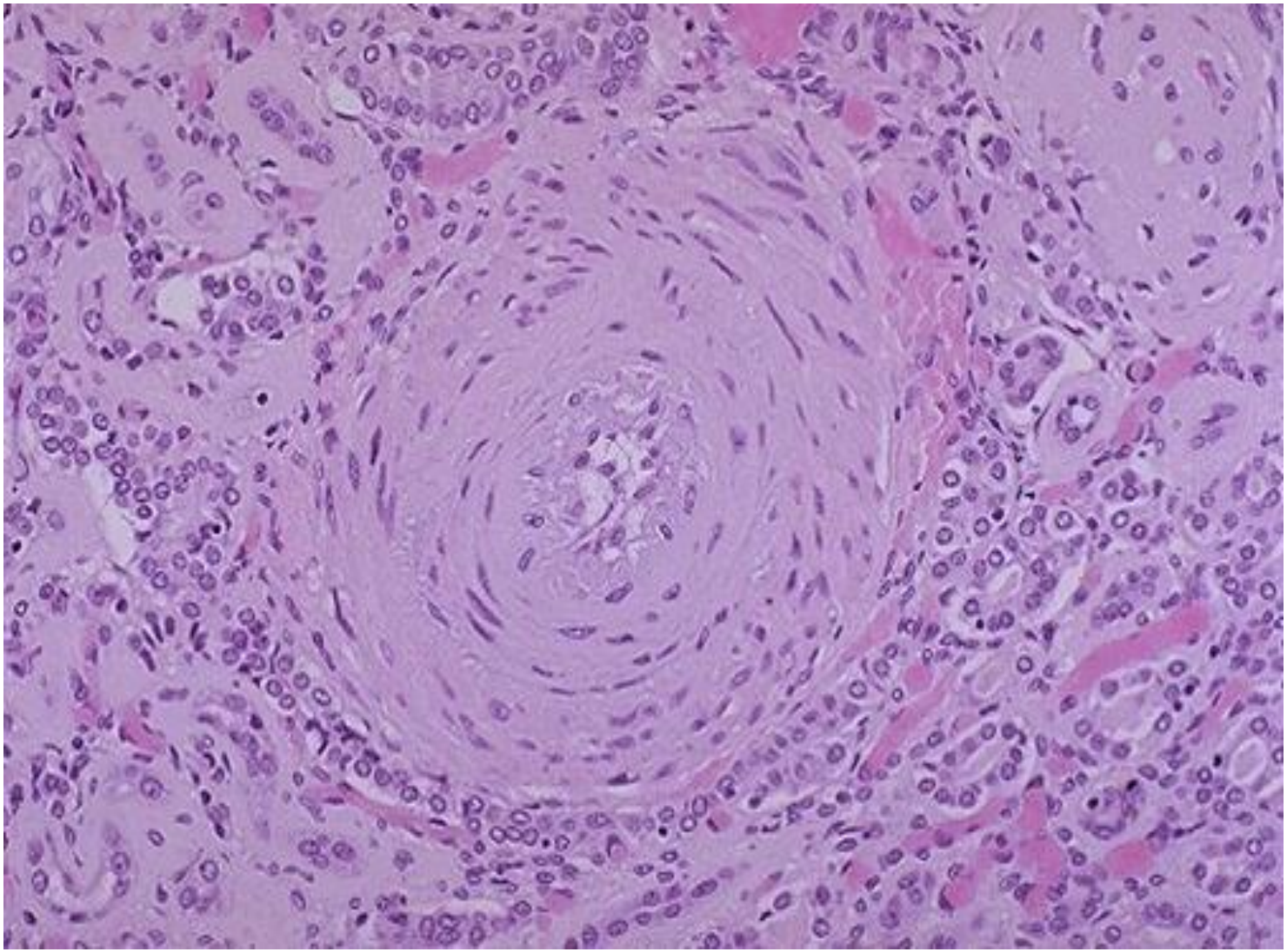




Hyperplastic arteriolosclerosis

- Commonly in malignant hypertension
- Due to proliferating smooth muscle and thickened duplicated BM.
- Onion skin , concentric , laminated thickening of the blood vessel
- Narrowing of the vascular lumen

Hyperplastic arteriolosclerosis



Necrotizing arteriolitis

- In malignant hypertension
- Fibrinoid necrosis of vessel wall

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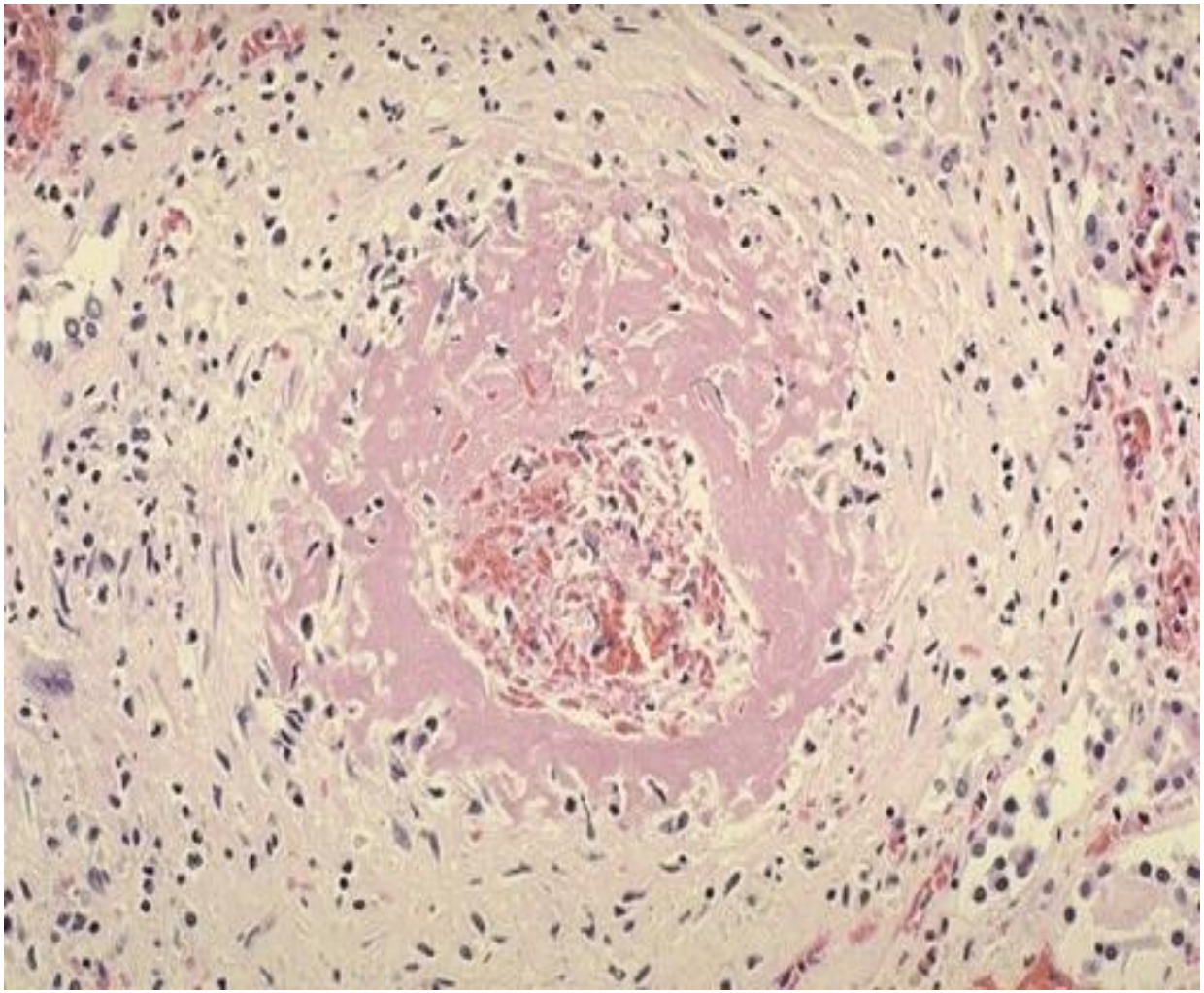
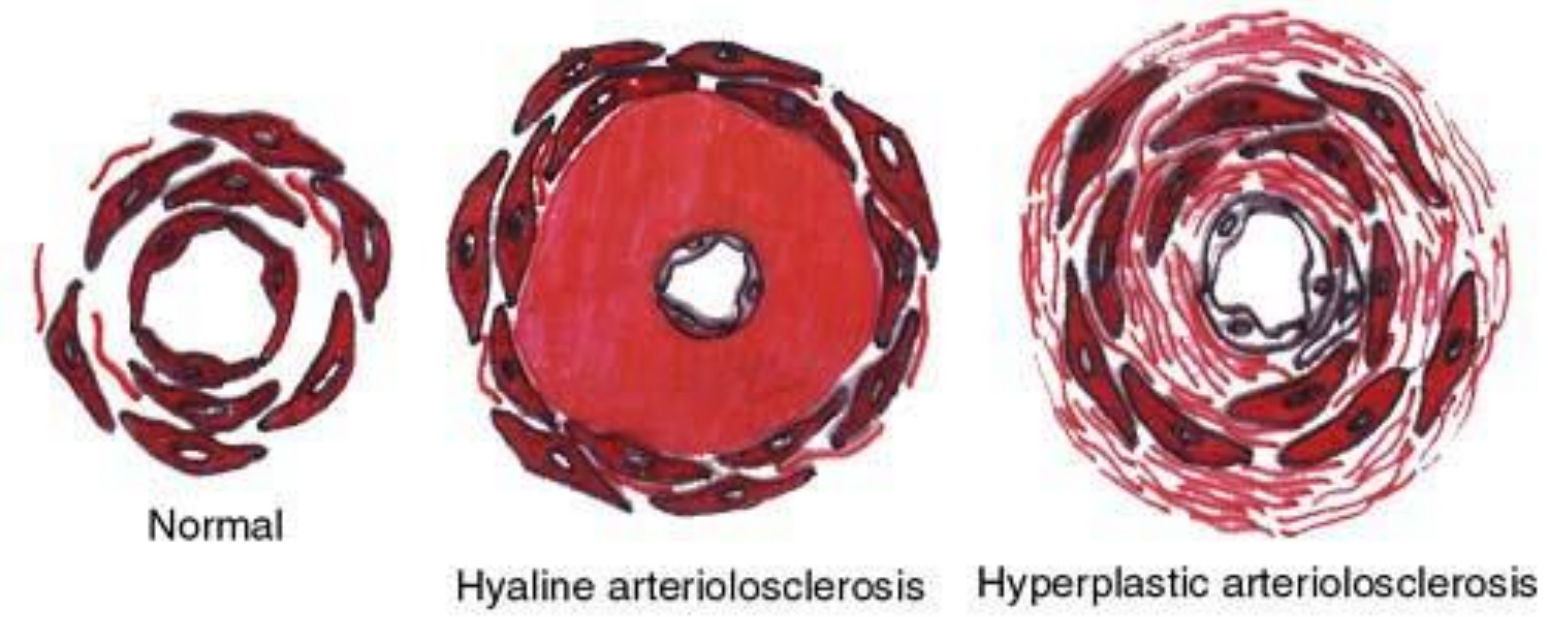
Haemorrhage and microinfarcts of the affected organ

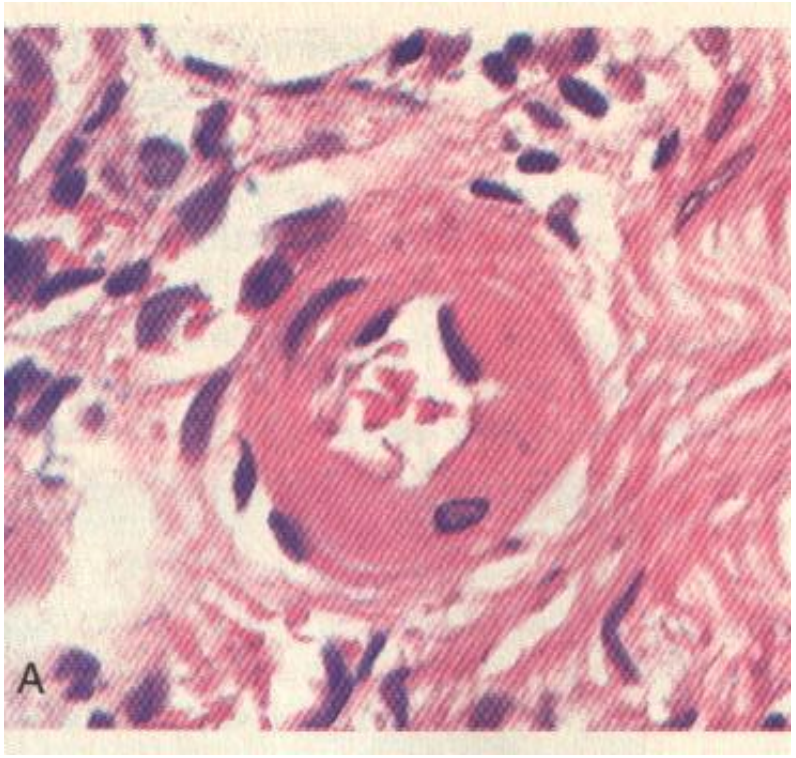
Necrotizing arteriolitis

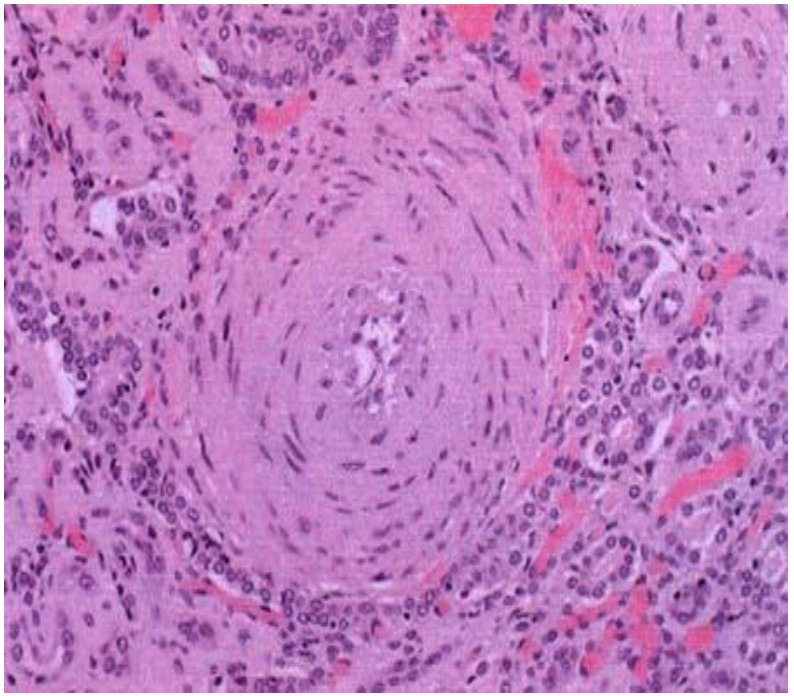


Benign vs Malignant arteriolosclerosis

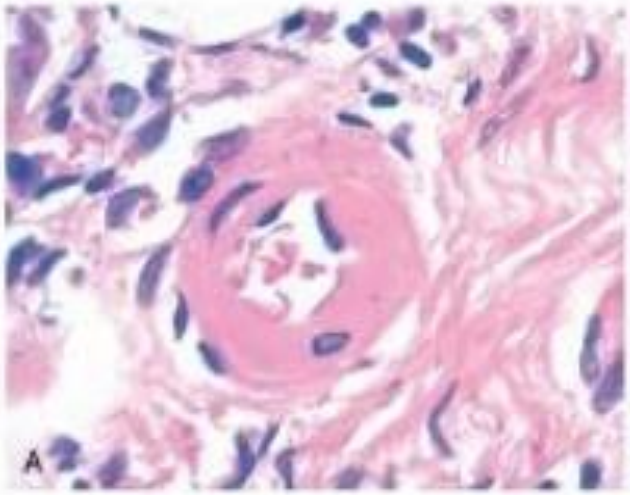


Benign vs Malignant arteriolosclerosis

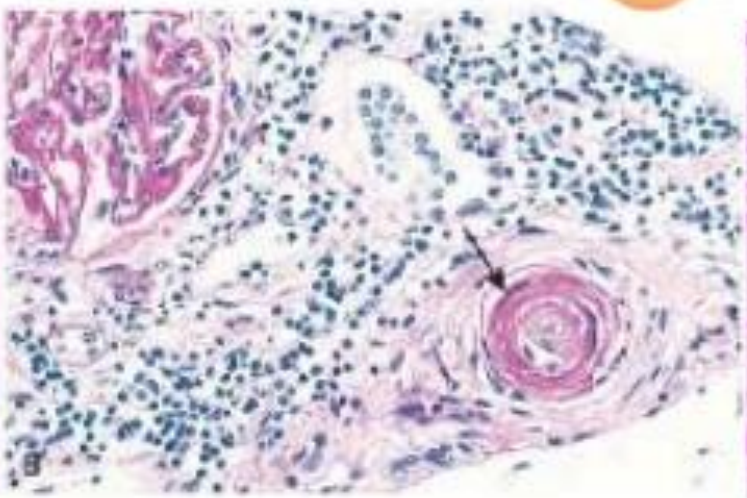




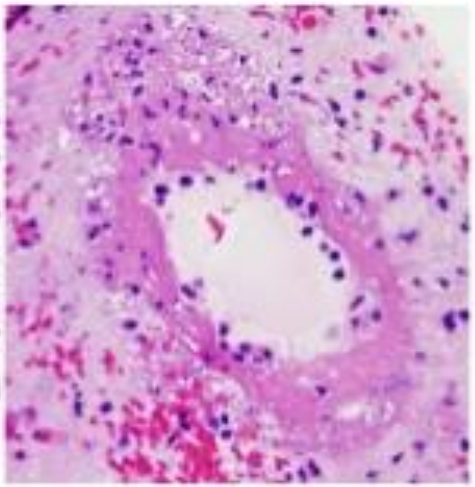
Hypertension: Microscopic Features



hyaline arteriolosclerosis



hyperplastic arteriolosclerosis



fibrinoid necrosis

2) Pathological changes in the Heart

Macroscopy-

- Enlarged
- Weight - > 500 gm (normal - 300gm)
- L/ventricle - thickening of the wall

  >2cm (Normal - 1.3 - 1.5cm)

This impairs diastolic function.

(Ventricle is perfused during diastole)

- Later congestive heart failure

Hypertensive changes in the heart

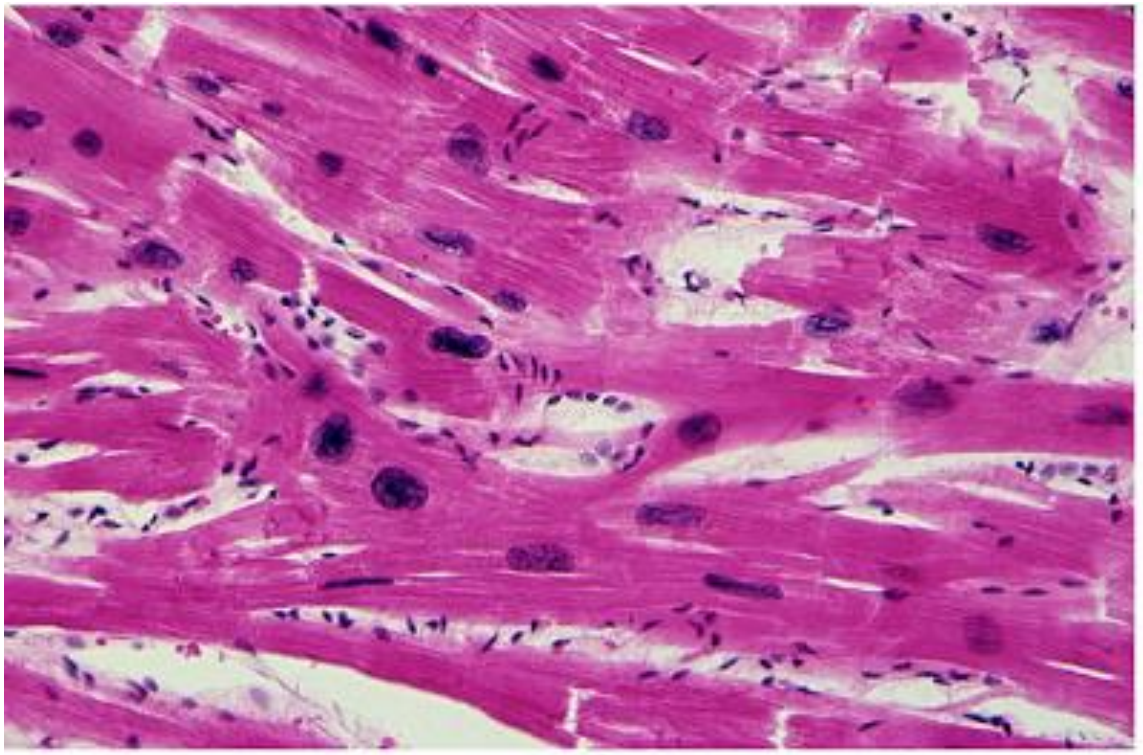
The left ventricle is markedly thickened in this patient with severe hypertension that was untreated for many years. The myocardial fibers have undergone hypertrophy.

This left ventricle is thickened (slightly over 2 cm in thickness)

2) Pathological changes in th Heart

Micro -

- Cellular and nuclear enlargement
- Variation in cell size
- Interstitial fibrosis



How coronary perfusion is affected in hypertension

- Increased demand due to hypertrophy.
- Impaired diastolic function
- Coronary atheroma

Poor perfusion

IHD

3)Renal changes

- Benign Nephrosclerosis
- Malignant Nephrosclerosis

3) Renal changes

A) Benign nephrosclerosis

Macroscopy

- Symmetrically contracted kidneys
- Fine granular surface
- c/s - cortex thinned

Kidney in benign hypertension

Microscopy

1) Vascular -

- Hyaline arteriolosclerosis - arterioles

2)Parenchyma

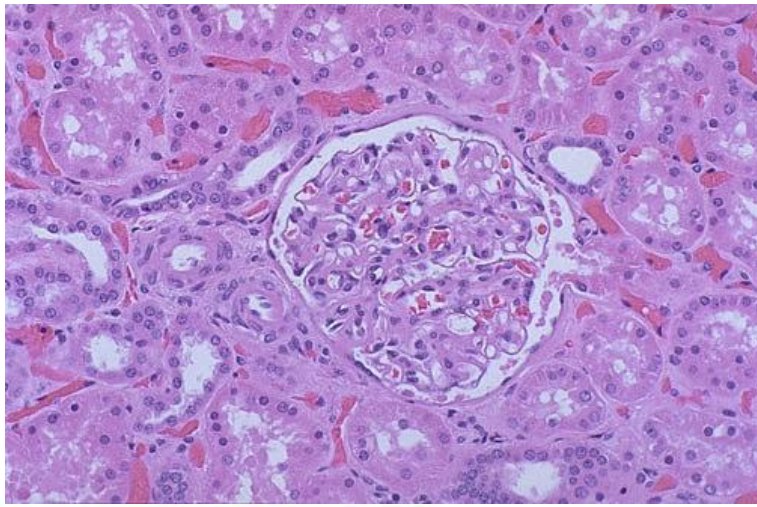
- Interstitial fibrosis
- Tubular atrophy
- *Glomeruli*

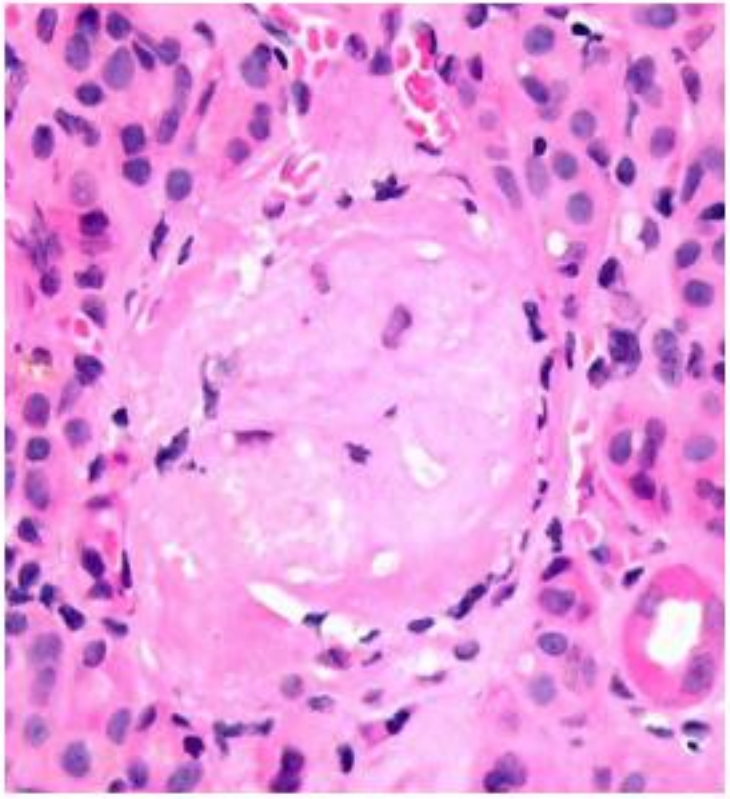
    Periglomerular fibrosis

    Glomerular collapse

    Sclerosis

Benign Nephrosclerosis





Glomerulosclerosis

B) Malignant nephrosclerosis

Macro-

- Pinpoint haemorrhages on the surface

  -flea bitten kidney-

Micro -

1)Vascular

- Fibrinoid necrosis of arterioles

  ↓

  Rupture / luminal thrombosis → Small infarcts

- Hyperplastic arteriolosclerosis

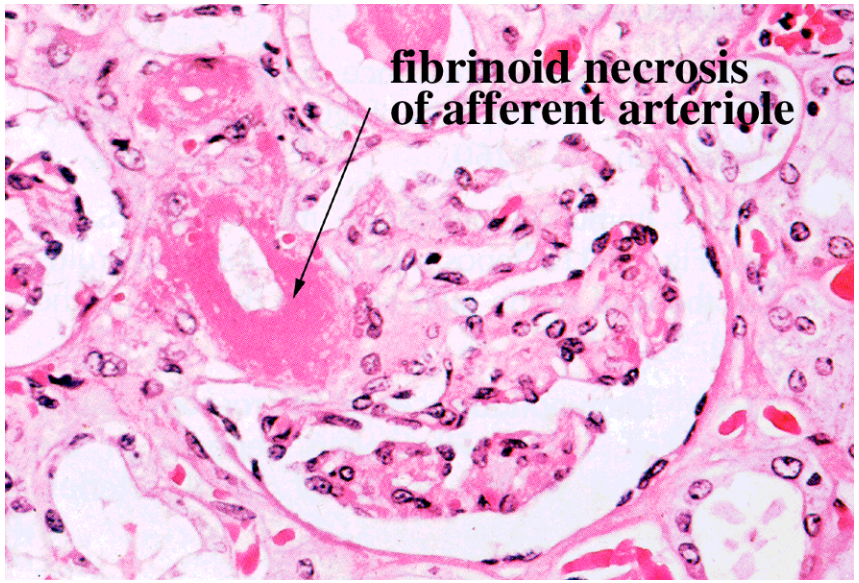
  Interlobular arteries and arterioles

2)Parencyma

- Glomeruli - Thrombosed capillaries/necrosis

  Fibrinoid necrosis

  ischaemic atrophy/infarction


fibrinoid necrosis
of afferent arteriole


onion skin lesion

Hypertensive cerebrovascular disease

- ICH
- Lacunar infarcts
- Slit haemorrhages
- Hypertensive encephalopathy

4)Central nervous system

1)Hyaline arteriolosclerosis ⟶ Infarction

2) Microaneurysm formation in small penetration vessels ⟶ Haemorrhage

3) Atherosclerosis ⟶ Infarction and haemorrhage

4)Hypertensive encephalopathy

- Oedematous brain
- Fibrinoid necrosis of vessels
- Petichial haemorrhages

Complications of hypertension

Benign HPT

- Cerebrovascular disease
- Coronary artery disease
- Cardiac failure
- Peripheral vascular disease
- May lead to renal failure

Malignant HPT

- Renal failure
- Heart failure
- Aortic dissection
- Cerebrovascular disease
- Hypertensive encephalopathy

Thank you