HYPERTENSIVE VASCULAR DISEASE

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Learning Objective

- Define hypertension
- What are the possible causes of essential HT?

HYPERTENSION

Source: Schwinghammer TL: *Pharmacotherapy Casebook: A Patient-Focused Approach*, 7th Edition: http://www.accesspharmacy.com

- It is elevated blood pressure
- Diastolic blood pressure above **90mmHg** and systolic above **140mmHg**
- Current clinical criteria for defining hypertension are generally based on the **average of two or more seated blood pressure readings** during each of two or more outpatient visits

Adult Classification

Classification	Systolic Blood Pressure (mmHg)		Diastolic Blood Pressure (mmHg)
Normal	Less than 120	and	Less than 80
Prehypertension	120-139	or	80-89
Stage 1 hypertension	140-159	or	90-99
Stage 2 hypertension	≥ 160	or	≥ 100

Chobanian AV, Bakris GL, Black HR, et al. Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. Hypertension 2003;42(6):1206–1252.

Classification for Adults

- Classification based on average of ≥ 2 properly measured seated BP measurements from ≥ 2 clinical encounters
- If systolic & diastolic blood pressure values give different classifications, classify by highest category
- **≦ 130/80 mmHg**: above goal for patients with diabetes mellitus or chronic kidney disease
- **Prehypertension**: patients likely to develop hypertension

Risk factors

- Obesity and weight gain
- High NaCl intake
- Alcohol consumption
- Psychosocial stress
- Lack of physical activity
- Hereditary
- Male gender
- Smoking
- Race – black
- Age
- Low calcium, K, Mg intake
- Glucose intolerance

Types of hypertension

1. Essential hypertension, primary, idiopathic, (unknown cause) forms 90-95% of hypertension
2. Secondary hypertension

Causes secondary hypertension

1. Renal
   - Renal parenchymal disease
   - Renal artery stenosis
   - Renal tumors
2. Endocrine
   - Cushing syndrome
   - Primary aldosteronism
   - Pheochromocytoma
   - Pregnancy related – pre-eclampsia, eclampsia
3. Cardiovascular
   - Coarctation of the aorta
4. Neurologic
   - Acute stress
   - Increased intracranial pressure
5. Medications
   - High-dose estrogens, steroids

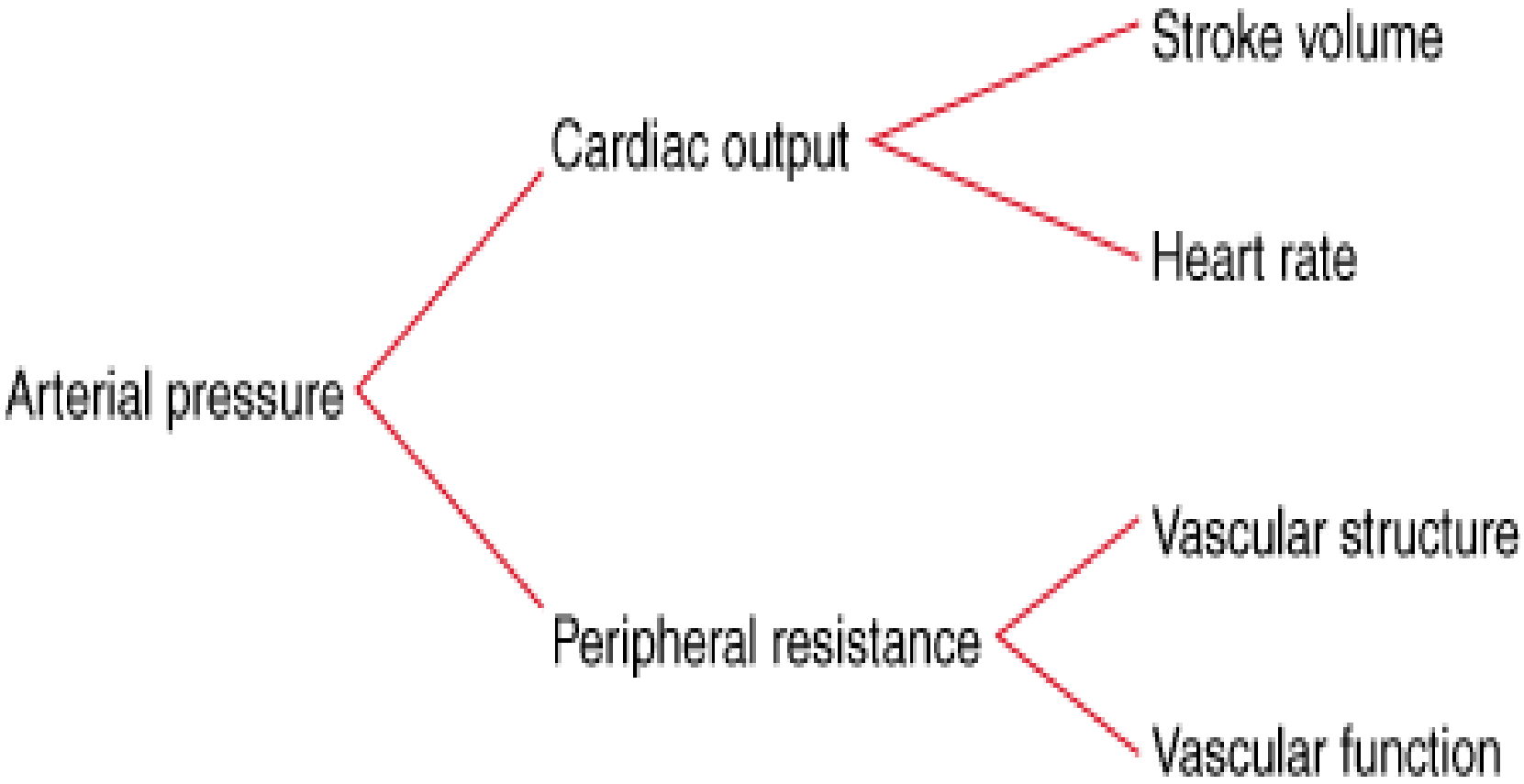
Malignant hypertension

- About 5% of hypertensive persons show a rapidly rising blood pressure that if untreated leads to death within 1 or 2 years.
- It is termed ***accelerated* or *malignant hypertension***, the clinical syndrome is characterized by
  1. severe hypertension (diastolic pressure over 120mmHg),
  2. renal failure, and
  3. retinal haemorrhages and exudates, with or without papilledema.
- It may develop in previously normotensive persons but more often is superimposed on pre-existing hypertension, either essential or secondary.

Regulation of blood pressure

- Cardiac output and peripheral resistance are the two determinants of arterial pressure
- Cardiac output is affected by blood volume, itself strongly dependent on sodium concentrations
- Peripheral resistance is regulated predominantly at the level of the arterioles and is influenced by neural and hormonal inputs
- Blood pressure = cardiac output X peripheral resistance
- Read more on autoregulation, renin-angiotensin system etc

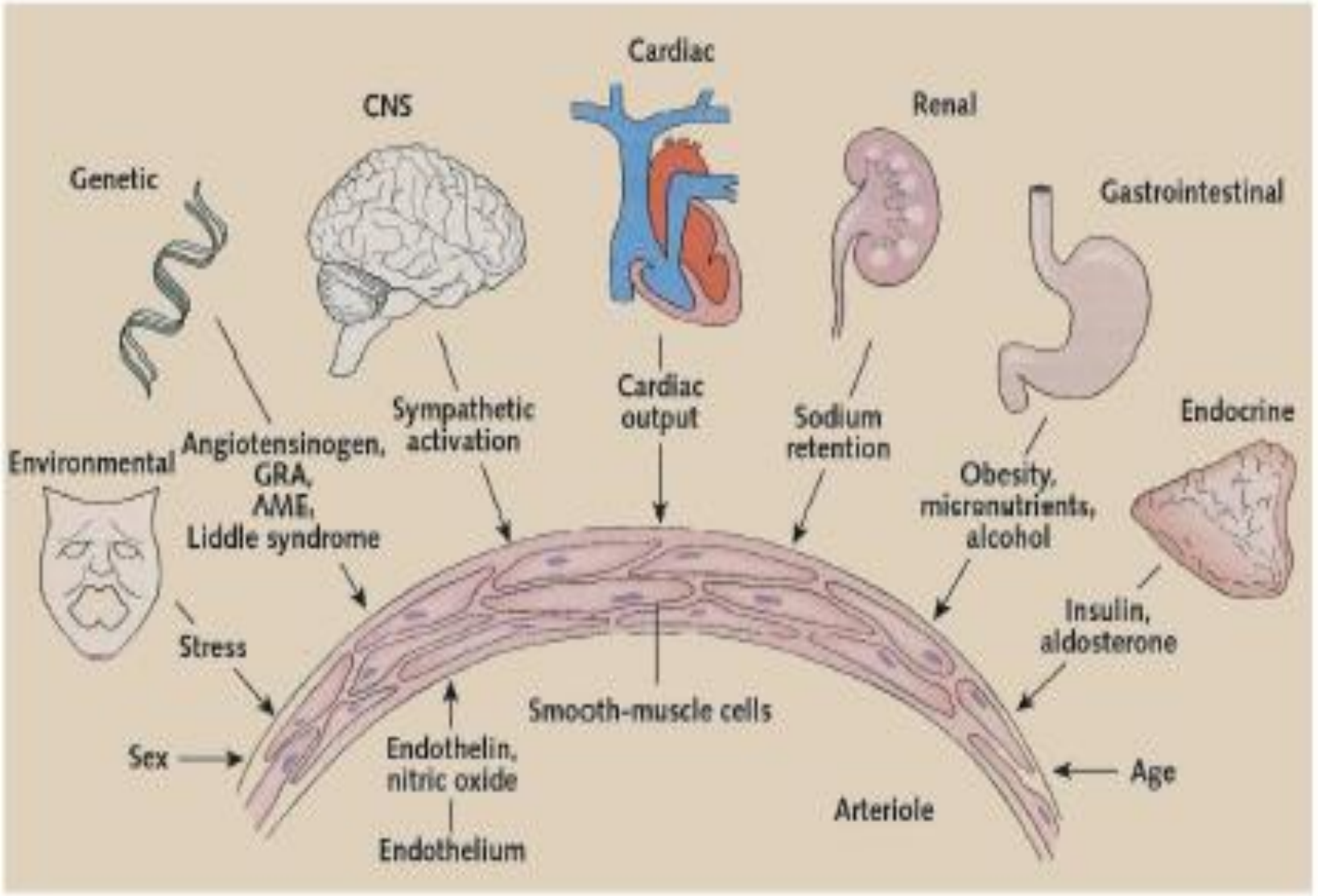
Arterial Pressure Determinants



Source: Fauci AS, Kasper DL, Braunwald E, Hauser SL, Longo DL, Jameson JL, Loscalzo J: *Harrison's Principles of Internal Medicine*, 17th Edition: http://www.accessmedicine.com

KIDNEYS AND BLOOD PRESSURE RUGULATION
THE "RENIN-ANGIOTENSIN SYSTEM"

1. Decrease in blood pressure causes decrease in amount of extracellular fluid.
2. Decrease in extracellular pressure near distal convoluted tubule causes juxtaglomerular cells to release the hormone RENIN.
3. RENIN in blood stream converts the liver enzyme ANGIOTENSINOGEN into ANGIOTENSIN I.
4. ANGIOTENSIN CONVERTING ENZYME (in the lung) converts Angiotensin I into ANGIOTENSIN II.
5. Angiotensin II causes ADRENAL GLAND to secrete/release ALDOSTERONE.
6. Aldosterone is a vasoconstrictor (increasing blood pressure) and INCREASES COLLECTING DUCT PERMIABILITY.
7. Urine volume decreased, fluid retained, blood volume increases, blood pressure up.



From Oparil et al. Pathogenesis of Hypertension *Ann Inn Med 2003;139:761*

Secondary Hypertension

Kidney: 1. Renal artery stenosis

artery stenosis of kidney
→ increased renin excretion by affected kidney
→ increased angiotensin II
→ increased blood pressure by increased vasoconstriction and increased ECF volume due to increased NaCl retention

Mechanisms of Pathogenesis

- Increased cardiac output (CO):
  - increased preload:
    - increased fluid volume
    - excess sodium intake
    - renal sodium retention

Mechanisms of Pathogenesis

- Increased peripheral resistance (PR):
  - vascular constriction:
    - excess RAAS stimulation
    - sympathetic nervous system overactivity
    - genetic alterations of cell membranes
    - Endothelial factors

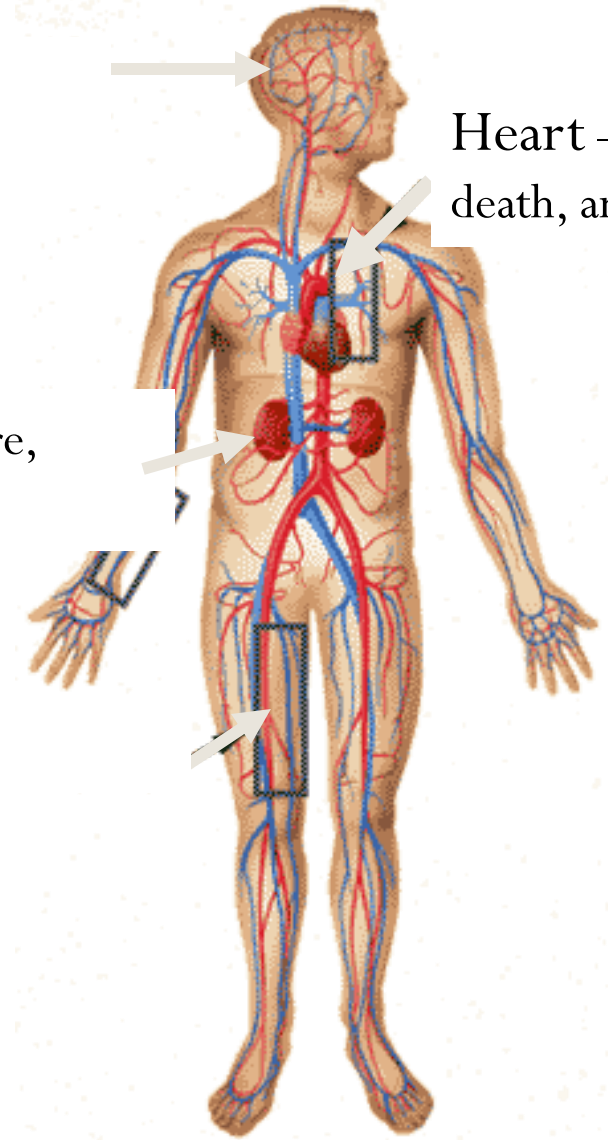
Target-Organ Damage

- Brain: stroke, transient ischemic attack, dementia
- Blood vessel: atherosclerosis
- Eyes: retinopathy
- Heart: coronary artery disease, left ventricular hypertrophy
- Kidney: nephrosclerosis, chronic kidney disease
- Peripheral Vasculature: peripheral arterial disease

Consequences of Hypertension

CNS - Stroke, retina damage

Heart – LVH, CHF, MI, Sudden death, angina

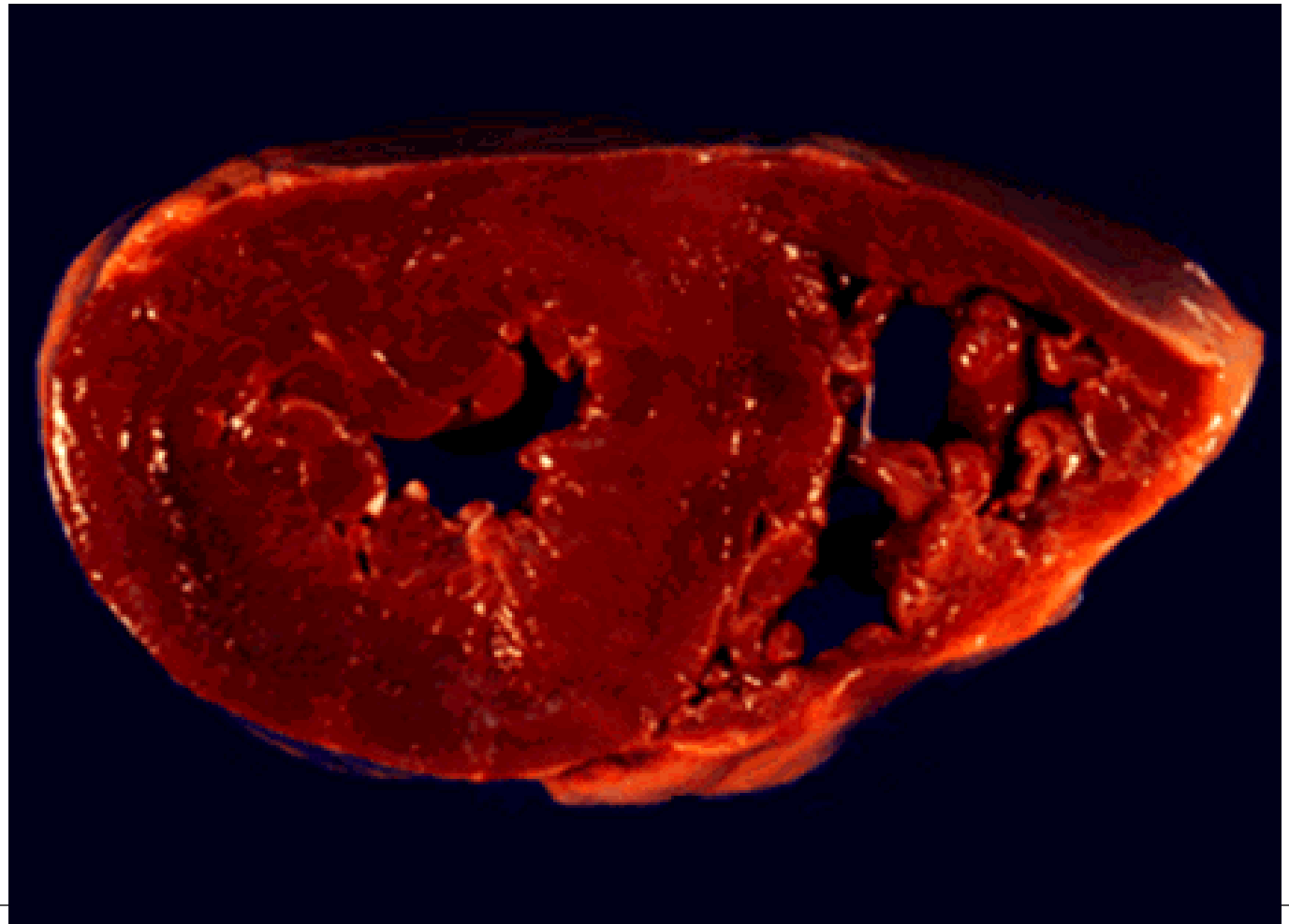


Kidneys - renal failure, proteinuria

Peripheral Vascular disease

Consequences of Hypertension

- Cardiac - LVH



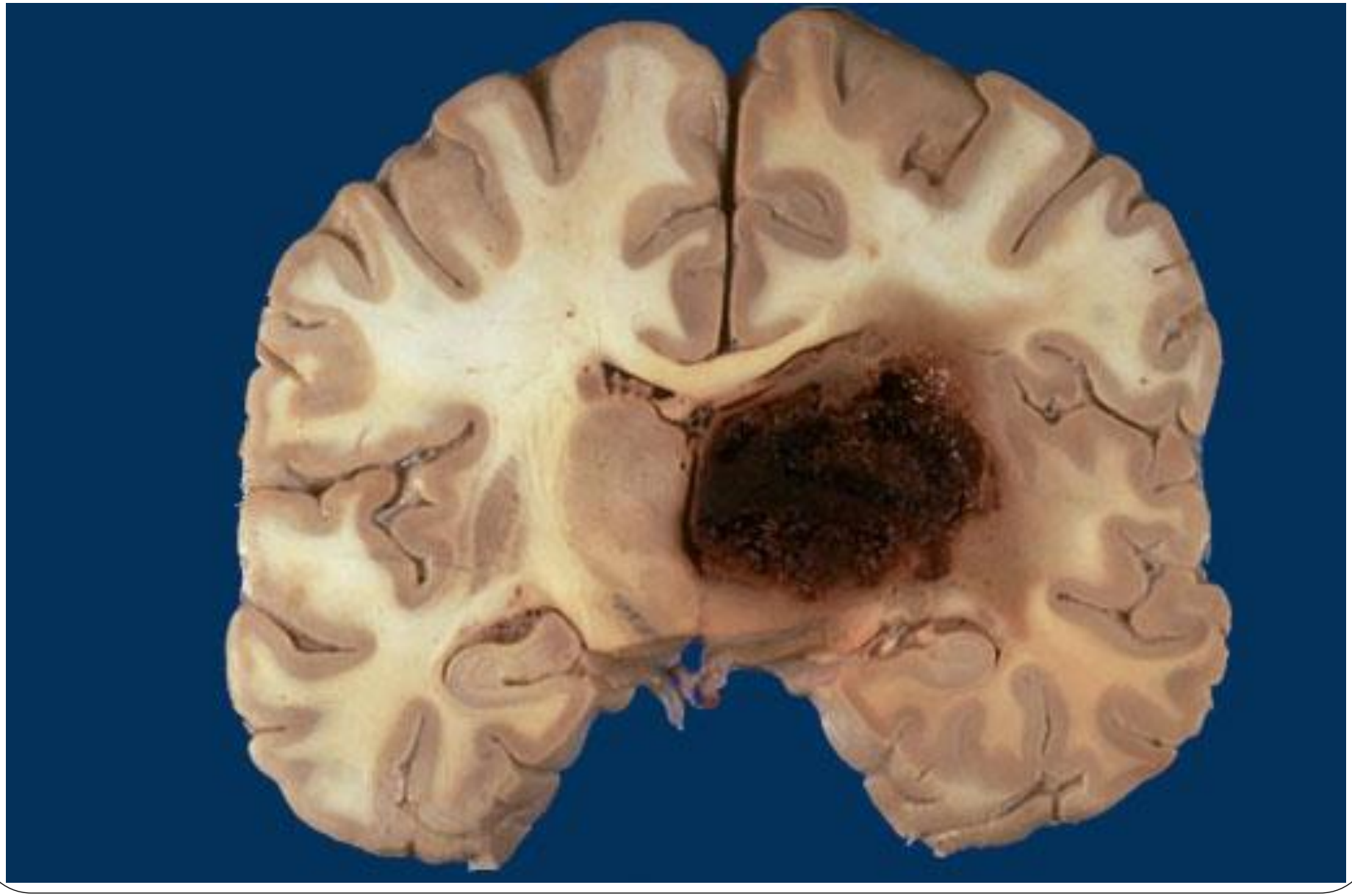
Brain

- HTN is a risk factor for brain infarction and hemorrhage
- Approximately 85% of strokes are due to infarction and the remainder are due to hemorrhage, either intracerebral hemorrhage or subarachnoid hemorrhage
- Hypertension is also associated with impaired cognition in an aging population and dementia
- Treatment of hypertension decreases the incidence of both ischemic and hemorrhagic strokes

contd

- Cerebral blood flow remains unchanged over a wide range of arterial pressures through a process termed *autoregulation* of blood flow
- In malignant hypertension, encephalopathy is related to failure of autoregulation of cerebral blood flow
- Signs and symptoms of hypertensive encephalopathy may include severe headache, nausea and vomiting (often of a projectile nature), focal neurologic signs, and alterations in mental status
- Untreated, hypertensive encephalopathy may progress to stupor, coma, seizures, and death within hours

Consequences of Hypertension - CNS

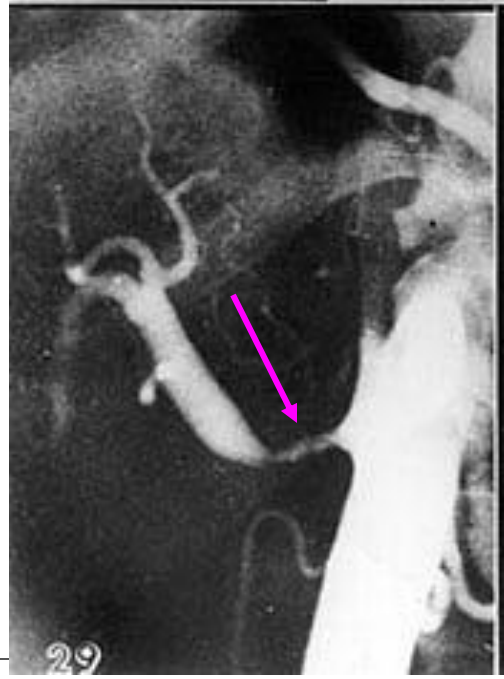


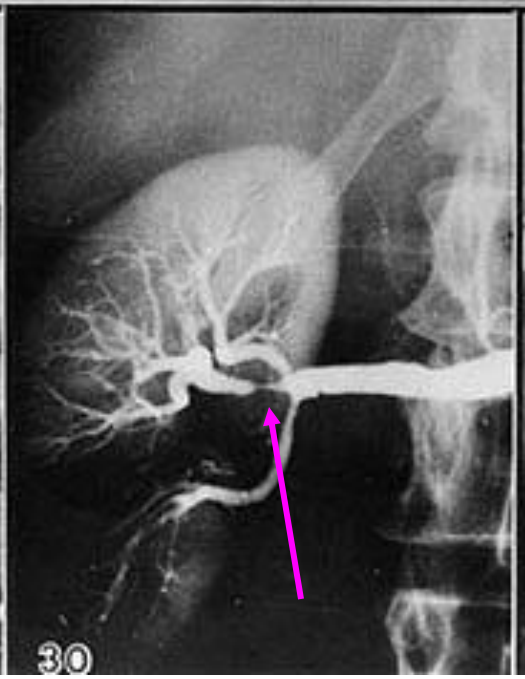
Kidney

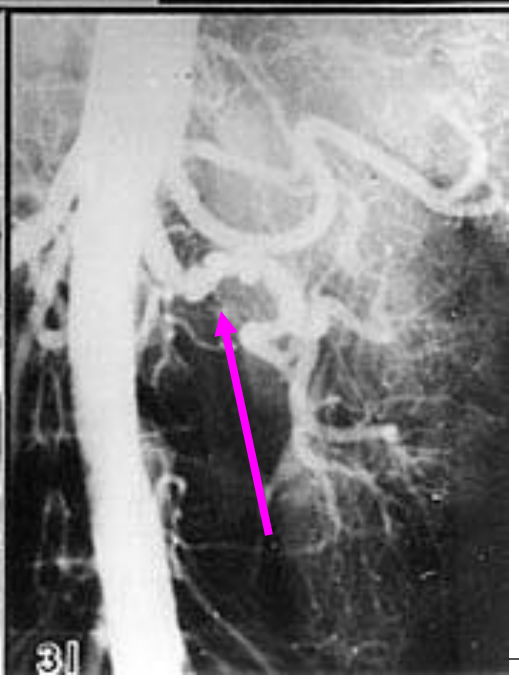
- Primary renal disease is the most common aetiology of secondary hypertension
- Conversely, hypertension is a risk factor for renal injury and ESRD
- The atherosclerotic, hypertension-related vascular lesions in the kidney primarily affect the preglomerular arterioles, resulting in ischemic changes in the glomeruli and postglomerular structures
- Glomerular pathology progresses to glomerulosclerosis, and eventually the renal tubules may also become ischemic and gradually atrophic

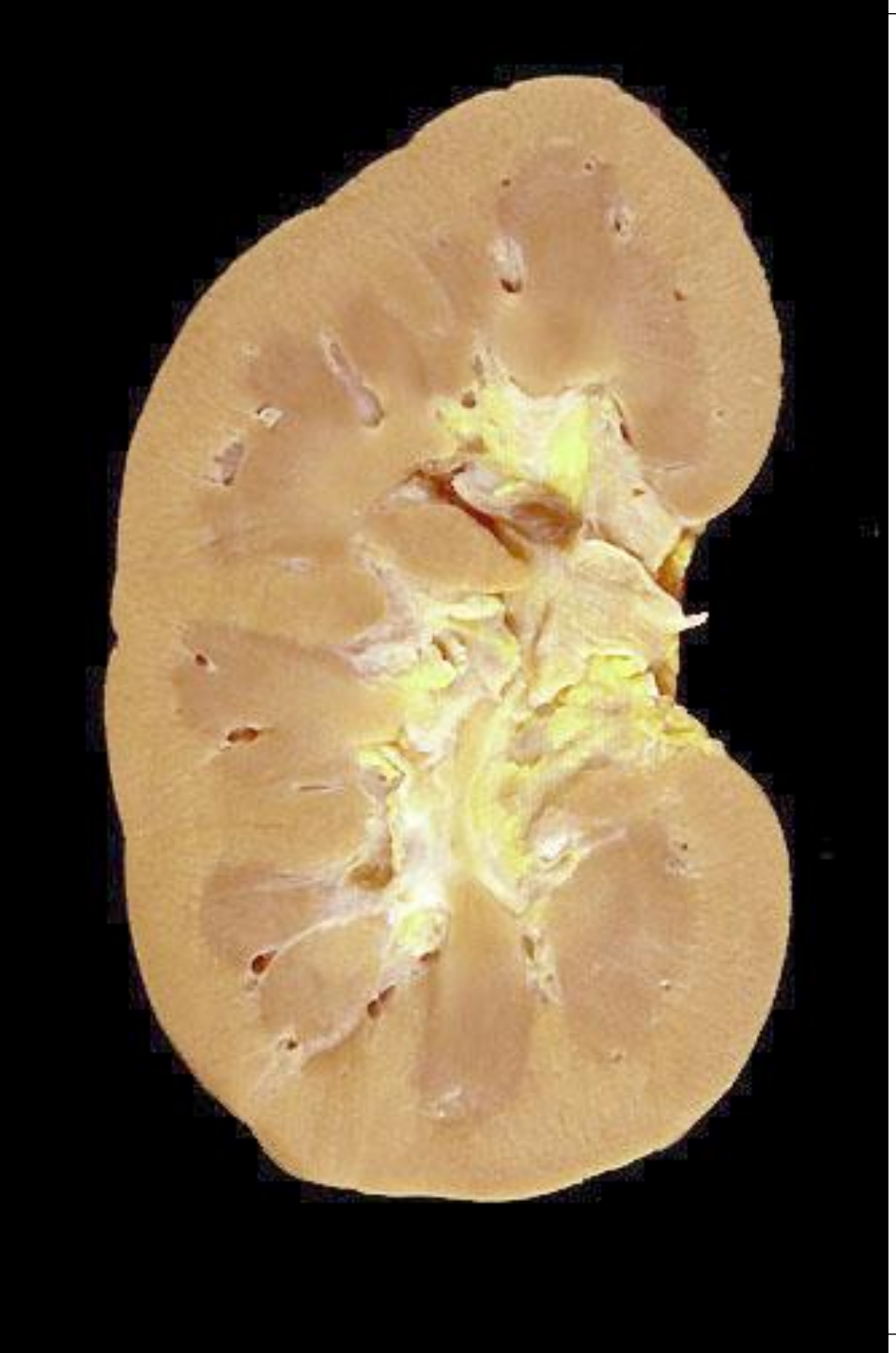
Side with stenosis

"Flea-bitten"









Benign Nephrosclerosis

Peripheral arteries

- In addition to contributing to the pathogenesis of hypertension, blood vessels may be a target organ for atherosclerotic disease secondary to long-standing elevated blood pressure
- Hypertensive patients with arterial disease of the lower extremities are at increased risk for future CVS disease
- Although patients with stenotic lesions of the lower extremities may be asymptomatic, intermittent *claudication* is the classic symptom of PAD. This is characterized by aching pain in the calves or buttocks while walking that is relieved by rest

Consequences of Hypertension -Peripheral Vascular Disease

Investigations

- Investigations are helpful in establishing
  - Risk factors
  - The aetiology of hypertension
  - Quantifying severity of target organ damage
  - Monitoring adverse effects of therapy

Hypertensive heart disease

- Risk factors
  - Hyperlipidaemia- Lipid profile
  - Diabetes mellitus- RBS, FBS

Hypertensive heart disease

- Secondary causes of hypertension:
  - U/E/C (Urea, Electrolytes and creatinine) – elevated in patients with renal failure
  - Potassium- hyperaldosteronism, Cushing disease
  - Urinary Catecholamines and metanephrines elevated in patients- pheochromocytoma
  - Cortisol- cushings disease
  - T4, T3, TSH in patients with hyper and hypothroidism

Lab investigations

Basic lab tests for initial evaluation	
System	Test
Renal	Urinalysis-protenuria, Urea, creatinine, electrolytes
Metabolic	FBS, lipid profile
Endocrine	Sodium, potassium
Others	Hematocrit, electrocardiogram (ECG)

HTN treatment

1) Lifestyle modification

- Weight reduction (BMI <25)
- Decrease salt intake (<6g NaCl/day)
- Moderation of alcohol consumption
- Physical activity

2) Drugs

- Diuretics
- Beta blockers
- ACE- inhibitors
- Calcium channel blockers
- vasodilators

Conclusion

- Blood pressure results from two main parameters: cardiac output and total peripheral resistance
- Hypertension is a serious disease with many causes and many effects
- Hypertension is a 'multi organ' and a 'multi factor' disease
- Two main types: essential and secondary hypertension
- Symptoms caused by hypertension affect many organs (Vessels, kidney, heart, eyes)
- Effect on vessels and kidney can increase and promote the hypertension