

# ***HYPERTENSION***

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## ■ ***Diagnosis of hypertension:***

- 1. multiple readings (under various conditions and times) for at least 4-6 weeks
- 2. 24-hour ambulatory blood pressure recordings (especially if variable readings)

## ***Types of hypertension:***

- 1. Primary, essential, or idiopathic hypertension (>90%)
- 2. Secondary, identifiable, hypertension (<10%)

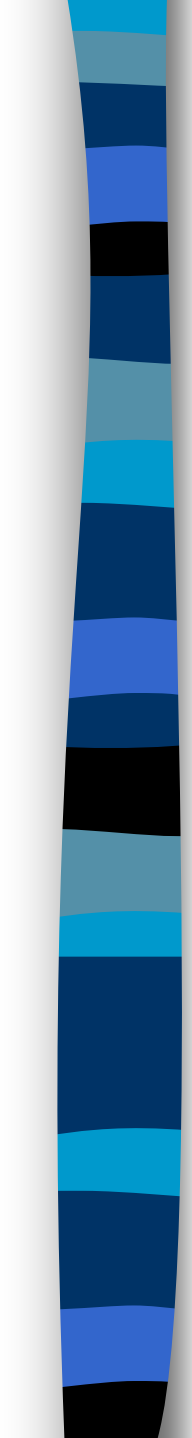
## JNC7 Classification of hypertension

<u>Blood pressure</u> <u>Classification</u>	<u>Systolic BP</u> <u>(mmHg)</u>	<u>Diastolic BP</u> <u>(mmHg)</u>
normal	< 120	< 80
prehypertension	120-139	80-89
stage 1 hypertension	140-159	90-99
stage 2 hypertension	<u>≥ 160</u>	<u>≥ 100</u>

- Prehypertension is not disease category and not for drug therapy (lifestyle modification needed to reduce risk of developing hypertension)
- All people with stage 1 or 2 hypertension need drug therapy. Treatment goal is < 140/90 mmHg. If there are diabetes or kidney disease, treatment goal is < 130/80 mmHg.

# *Mechanisms of primary hypertension*

- Idiopathic (mostly)
- genetic and environmental factors
- renal retention of excess sodium → fluid overload → increase cardiac output
- pressor hormones and locally acting substances acting as vascular growth promoters leading to hypertension, as below:



**obesity (hyperinsulinemia)**  
**stress (catecholamines)**  
**sodium excess (natriuretic hormone)**  
**renal ischemia (angiotensin)**  
**acromegaly (growth hormone)**  
**endothelial cell dysfunction**  
**(decrease nitric oxide release and endothelial-derived constricting factors) etc.**

**pressor growth promoters**

**turnover of cell membrane phospholipids**

**heart: increase preload**  
**increase contractility**

**increase cardiac output**

**vessels: functional constriction**  
**structural hypertrophy**

**increased peripheral resistance**

**hypertension (= cardiac output X peripheral resistance)**

# Mechanisms of secondary hypertension

## 1. Renal parenchymal disease (most common)

- hypertensive nephrosclerosis
- diabetic nephropathy
- ureteral obstruction
- vasculitis
- polycystic kidney disease
- analgesic nephropathy (due to prolonged use of analgesics) etc.

## 2. Renovascular hypertension

- due to atherosclerotic or fibroplastic diseases → obstruction of renal artery

Diagnosis = isotopic renography

plasma renin measurement after  
oral catopril challenge

renal arteriography

renal vein renin assay

magnetic resonance arteriography

- **Adrenal disease:** due to excess of aldosterone, cortisol, catecholamines
  - **primary aldosteronism:** considered when hypertension and hypokalemia coexist, and high plasma aldosterone/renin ratio.  
Diagnosed by adrenal CT or MRI (for adrenal adenoma)
  - **congenital adrenal hyperplasia**
  - **pheochromocytoma:** diagnosed by urine or plasma assays of catecholamines, followed by adrenal CT or MRI to localize the tumor
- 4. **Coarctation of aorta** = congenital narrowing of aorta at any level of thoracic or abdominal aorta → hypertension in arms but weak or absent femoral pulses. Diagnosed by echocardiogram, aortography.
- 5. **Hormonal disturbances** eg. acromegaly, hypo- and hyperthyroidism, hyperparathyroidism, Cushing syndrome, etc.
- 6. Oral contraceptive, drugs, pregnancy-induced hypertension, neurological disorders (brain tumor, encephalitis, sleep apnea etc)

# Complications of hypertension

Hypertension → pulsatile flow, endothelial cell dysfunction, smooth muscle cell hypertrophy → vascular complications

## Vascular complications:

1. Hypertensive: accelerated-malignant hypertension, hemorrhagic stroke, heart failure, nephrosclerosis, aortic dissection
2. Atherosclerotic: coronary artery disease, sudden death, arrhythmias, atherothrombotic stroke, peripheral vascular disease

## Target organ damage:

1. Eye : hypertensive and arteriosclerotic retinopathy
2. Heart: left ventricular hypertrophy, sudden death, myocardial ischemia and infarction
3. Kidney: microalbuminuria, proteinuria, nephrosclerosis, renal insufficiency, uremia, end-stage renal disease
4. Brain: stroke

Metabolic abnormalities eg. dyslipidemia, hyperinsulinemia

## *Association of hypertension with other conditions:*

obesity, sleep apnea, physical inactivity, excess alcohol intake, smoking, hematologic disease (eg polycythemia), hyperuricemia, diabetes etc.

## *Screening for secondary hypertension*

If there are features of “inappropriate hypertension”, such as:

- onset before age 20 or after 50
- organ damage eg. serum creatinine > 1.5 mg/dl, cardiomegaly etc.
- hypokalemia, abdominal bruit, variable pressures with tachycardia, sweating, tremor, family history of renal disease etc.
- poor response to antihypertensive treatment

# Hypertensive crisis

- Mostly appear in the setting of preexisting primary hypertension (< 1%)

## Characteristics:

- diastolic pressure > 140 mmHg
- funduscopic findings: hemorrhage, exudate, papilledema
- neurologic findings: headache, confusion, somnolence, stupor, visual loss, focal deficits, seizure, coma
- cardiac findings: prominent apical impulse, cardiac enlargement, heart failure
- renal findings: oliguria, azotemia
- gastrointestinal : nausea vomiting

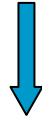
# *Therapy of hypertension*

life style modification

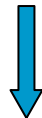


**Blood pressure (BP) > 140/90 mmHg**

**(for those with diabetes or renal disease, BP > 130/80)**



**without compelling indications**



**stage 1 hypertension:  
drugs"**

**thiazide for most**

**stage 2 hypertension:**

**two-drug combination for most**



**with compelling indications**



**"compelling**

- **Goal is to prevent complications**
- **Life style modifications (nondrug therapy):**  
**stop smoking and alcohol abuse, weight reduction, dietary sodium restriction, diet control, physical exercise**

## **COMMON ORAL ANTIHYPERTENSIVE DRUGS**

### **1. Diuretics:**

**mechanism of action – increase urinary sodium excretion and decrease plasma volume, cardiac output and peripheral resistance**

**side effects (if high dose) - hypokalemia, hypomagnesemia, hyperuricemia, hyperlipidemia, hyperglycemia and insulin resistance, hypercalcemia, poor sexual performance (also common in hypertension per se)**

## 2. Alpha blockers (eg. doxazosin)

- excellent for old men with hypertension and prostate hypertrophy because decreasing smooth muscle tone of bladder neck and prostate

mechanism of action: decrease peripheral resistance

side effects: postural hypotension, dizziness, weakness, headache

## 3. Beta blockers

mechanism of action: decrease cardiac output and renin release

side effects: bronchospasm, peripheral vascular disease, fatigue, insomnia, nightmares, hallucinations

- **Calcium antagonists**  
**mechanism of action:** vasodilator  
**side effects:** flushing, ankle edema, constipation
  
- 5. **Renin-angiotensin inhibitors (ACEI and ARB)**  
**mechanism of action:** decrease peripheral resistance with little effect on heart rate, cardiac output and plasma volume  
**side effects:** cough, hypersensitivity reaction

## ANTIHYPERTENSIVE DRUG THERAPY

- diuretics unsurpassed in preventing complications, therefore used as “preferred initial agent”
- if there are compelling indications (or contraindications), use the appropriate “compelling drugs”, as below:

**Class of drug**

**compelling indications**

**compelling contraindications**

**Diuretics**

**heart failure, elderly, coronary disease, systolic hypertension, diabetes, stroke prevention**

**gout, dyslipidemia, sexually active men**

**Beta blockers**

**coronary disease, post-infarction, tachyarrhythmia, heart failure, diabetes**

**asthma, chronic lung disease, heart block, dyslipidemia, peripheral vascular disease**

**ACE inhibitors** heart failure, coronary disease, post-infarction, diabetes, chronic renal disease, stroke prevention pregnancy, hyperkalemia, renal artery stenosis

**Angiotensin II antagonists** ACEI cough, heart failure pregnancy, renal artery stenosis, hyperkalemia

**Calcium antagonists** coronary disease, diabetes, elderly, systolic hypertension, peripheral vascular disease heart block, heart failure