

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	≥ 160	≥ 100

- 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%)**
- **Severe hypertension = systolic BP > 180 or diastolic BP > 120mmHg**
- **Hypertensive emergency = severe hypertension + acute end organ damages**
- **Hypertensive urgency = severe hypertension without acute end organ damages**

Characteristic end organ damages

- **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**

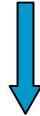
Therapy of hypertension

life style modification

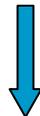


Blood pressure (BP) > 140/90 mmHg

(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