

Hypertension

Dr. Jamal Dabbas
Interventional cardiologist &
internist

Summary

Hypertension

Hypertension is a common condition that affects one in every three adults. It is defined by the

JNC 8 criteria as :

A blood pressure of $\geq 140/90$ mm Hg.

By the AHA/ACC guideline as $\geq 130/80$ mm Hg.

Hypertension can be classified as either primary (essential) or secondary.



Primary hypertension accounts for approx. 95% of cases of hypertension and has no detectable cause, whereas **secondary hypertension** is due to a specific underlying condition. Typical underlying conditions include renal, endocrine, or vascular diseases (e.g., renal failure, **primary hyperaldosteronism**, or **coarctation of the aorta**).



Clinically, hypertension is usually asymptomatic until organ damage occurs,

Which then commonly affects the brain, **heart, kidneys**, or eyes (e.g., retinopathy, **myocardial infarction, stroke**).

Common early symptoms of hypertension include **headache**, dizziness, **tinnitus**, and chest discomfort. Hypertension is diagnosed if blood pressure is persistently elevated on two or more separate measurements.



Further diagnostic measures include evaluation of possible organ damage (e.g., **kidney function tests**) and additional tests if an underlying disease is suspected.



Treatment of **primary hypertension** includes lifestyle changes (e.g., diet, weight loss, exercise) and pharmacotherapy. Commonly prescribed antihypertensive medications includes **ACE inhibitors, angiotensin receptor blockers, thiazide diuretics,** and **calcium channel blockers.**



To treat **secondary hypertension**, the underlying cause needs to be addressed. In cases of **hypertensive emergency**, a condition with a sudden and severe increase in blood pressure and impending end-organ damage, immediate treatment with intravenously administered antihypertensives is required to prevent serious consequences such as cerebral hemorrhage.

Definition

- JNC 8 definition: systolic blood pressure of ≥ 140 mm Hg and/or diastolic blood pressure ≥ 90 mm Hg.
- AHA/ACC definition (2017): systolic blood pressure of ≥ 130 mm Hg and/or diastolic blood pressure ≥ 80 mm Hg.

JNC 8

BP category	Systolic blood pressure (mm Hg)		Diastolic blood pressure (mm Hg)
Normal blood pressure	< 120	and	< 80
Prehypertension	120–139	or	80–89
Stage 1 hypertension	140–159	or	90–99
Stage 2 hypertension	≥ 160	or	≥ 100

AHA/ACC 2017

BP category	Systolic blood pressure (mm Hg)		Diastolic blood pressure (mm Hg)
Normal blood pressure	< 120	and	< 80
Elevated	120–129	and	< 80
Stage 1 hypertension	130–139	or	80–89
Stage 2 hypertension	≥ 140	or	≥ 90

Epidemiology

- Most common risk factor for **cardiovascular disease**
- One in three adults is affected (~ 65% among those ≥ 60 years of age)
- **African American** populations are more commonly affected than white or Asian populations.
- **60–75%** of **obese** and **overweight** patients are affected.

Etiology

- **Primary (essential) hypertension**
- Accounts for 85–95% of cases of hypertension in adults
- **No specific cause**; multifactorial etiology including genetic and environmental factors
- Non-modifiable risk factors
 - **Positive family history**
 - **Ethnicity (Africans)**
 - **Advanced age**
- Modifiable risk factors
 - **Obesity**
 - **Diabetes**
 - **Smoking**, excessive **alcohol** or **caffeine** intake
 - Diet high in **sodium**, low in potassium
 - Physical inactivity
 - Psychological stress

Secondary hypertension

- Accounts for 5–15% of cases of hypertension in adults.
- Caused by a **specific organic condition**
 - Endocrine hypertension
 - **Primary hyperaldosteronism (Conn syndrome)**
 - **Primary hyperparathyroidism**
 - **Pheochromocytoma**
 - **Hypercortisolism (Cushing syndrome)**
 - **Hyperthyroidism**
 - **Acromegaly**
 - **Congenital adrenal hyperplasia**

- **Renal hypertension**
 - **Renovascular hypertension** (e.g., due to renal artery stenosis)
 - **Polycystic kidney disease** (ADPKD)
 - Renal failure
(renal parenchymal hypertension)
 - **Glomerulonephritis**
 - Systemic **lupus** erythematoses
 - Renal tumors

- Others
 - **Coarctation of the aorta**
 - **Obstructive sleep apnea**
 - Medication: **sympathomimetic drugs, corticosteroids, NSAIDs, oral contraceptives**
 - Recreational drug use: **amphetamines, cocaine, phencyclidine**

Clinical features

Hypertension is usually asymptomatic until complications of end-organ damage arise or an acute increase in blood pressure occurs (**hypertensive urgency** below). Possible symptoms include:

- **Headaches**, esp. early morning or waking **headache**
- **Dizziness, tinnitus, blurred vision**
- Flushed appearance
- **Epistaxis**
- Chest discomfort, **palpitations; strong, bounding pulse** on palpation
- Nervousness
- Fatigue, sleep disturbances
- Additional symptoms of an underlying disease in **secondary hypertension** (“Etiology” above)
- Symptoms of **end-organ damage** (“Complications” below)



Since hypertension is often asymptomatic, regular screening is necessary to prevent end-organ damage!

Subtypes and variants

- **White coat hypertension (white coat effect)**
- **Definition:** arterial hypertension detected only in **clinical settings** or during **blood pressure measurement** at a **physician's practice**
- **Etiology:** anxiety experienced by the patient
- **Clinical features:** consistently **normal blood pressure** measurements and normalization of elevated blood pressure **outside of a clinical setting**
- **Diagnostics:** **24-hour** blood pressure monitoring

Isolated systolic hypertension (ISH)

Definition: increase in **systolic** blood pressure (≥ 140 mm Hg) with **diastolic** BP within normal limits (≤ 90 mm Hg)

- **Etiology**

- ISH in elderly: **decreased arterial elasticity** and **increased stiffness** \rightarrow **decreased arterial compliance**
- ISH secondary to increased **cardiac output**
 - **Anemia**
 - **Hyperthyroidism**
 - Chronic **aortic regurgitation**
 - AV fistula



- **Clinical features:**
 - Often asymptomatic
 - Signs of **increased pulse pressure:** e.g., **head pounding**, rhythmic nodding, or **bobbing of the head** in synchrony with heartbeats
 - Symptoms of hypertension (“clinical features” above)
- **Diagnostics:** “diagnosis of hypertension” below.
- **Treatment:** **thiazide diuretics** or **dihydropyridine calcium antagonists**
- **Prognosis:** high risk of cardiovascular events (**MI, stroke**, renal dysfunction)

Diagnosics

General approach

- **Blood pressure monitoring**
 - Repeated measurements on both arms → Hypertension is diagnosed if the average blood pressure of ≥ 2 readings obtained on ≥ 2 separate visits is elevated
 - Long-term **measurement of blood pressure** (24 hours)



- **Initial evaluation of newly diagnosed hypertensive patients: Stratification of cardiovascular risk: fasting blood glucose, lipid profile (HDL, LDL, and **triglycerides** levels)**
- Evaluation of end-organ damage and underlying causes
 - Complete blood count
 - Renal function tests: serum **creatinine** and **eGFR**
 - Serum **Na⁺, K⁺, and Ca²⁺**
 - **Urinalysis**
 - **TSH**
 - **Electrocardiogram (ECG)**



- **Evaluation of secondary hypertension** if an underlying condition is suspected (Next)



Approach to diagnosing secondary hypertension

General indicators of secondary hypertension

Young age (< 30 years) at onset of hypertension or onset of diastolic hypertension at an older age (> 55 years)

Abrupt onset of hypertension

End-organ damage that is disproportionate to the degree of hypertension

Recurrent **hypertensive crises**

Resistant hypertension: hypertension that is resistant to treatment with ≥ 3 antihypertensives of different classes

Symptoms/signs of hypertension/coexistent illnesses: Chest pain, shortness of breath, palpitations, claudication, peripheral edema, headaches, blurred vision, nocturia, hematuria, dizziness. Symptoms suggestive of secondary hypertension: Muscle weakness/tetany, cramps, arrhythmias (hypokalemia/primary aldosteronism), flash pulmonary edema (renal artery stenosis), sweating, palpitations, frequent headaches (pheochromocytoma), snoring, daytime sleepiness (obstructive sleep apnea), symptoms suggestive of thyroid disease (full list of symptoms).

Physical Examination A thorough physical examination can assist with confirming the diagnosis of hypertension and the identification of secondary hypertension and should include:

Circulation and heart: Pulse rate/rhythm/character, jugular venous pulse/pressure, apex beat, extra heart sounds, basal crackles, peripheral edema, bruits (carotid, abdominal, femoral), radio-femoral delay.

Other organs/systems: Enlarged kidneys, enlarged thyroid, increased body mass index (BMI)/waist circumference, fatty deposits and coloured striae (Cushing disease/syndrome).

Laboratory Investigations and ECG Blood tests: Sodium, potassium, serum creatinine and estimated glomerular filtration rate (eGFR). If available, lipid profile and fasting glucose and HbA1c. Urine test: urine analysis. 12-lead ECG: Detection of atrial fibrillation, left ventricular hypertrophy (LVH), ischemic heart disease. Additional Diagnostic Tests Additional investigations when indicated can be undertaken to assess and confirm suspicion of end organ damage or complications, coexistent diseases or/and secondary hypertension.

Imaging Techniques
Echocardiography: LVH, systolic/diastolic dysfunction, atrial dilation, aortic coarctation.
Kidneys/renal artery and adrenal imaging: Ultrasound/renal artery Duplex ; CT-/MR-angiography: renal disease, renal artery stenosis, adrenal lesions, other abdominal pathology.
Fundoscopy: Retinal changes, hemorrhages, papilledema, tortuosity, nipping.
Brain CT/MRI: Ischemic or hemorrhagic brain injury due to hypertension(only if CNS symptoms or signs).
Functional Tests and Additional Laboratory Investigations
Further testing for secondary hypertension (if suspected): Aldosterone-renin ratio, 24 hr urine catecholamine or metanephrines, late-night cortisol or other screening tests for cortisol excess.-Urinary albumin/creatinine ratio (if renal disease is suspected).-Serum kft , lipids , Ca, TSH .uric acid levels-Liver function tests

Diagnostic findings

- **Hypokalemia**

Underlying condition

- **Conn syndrome**
- **Renal artery stenosis**

Diagnostic findings

• **Metabolic alkalosis and \uparrow aldosterone-to-renin ratio**

Underlying condition

• **Conn syndrome**

Diagnostic findings		Underlying condition
•Difference in blood pressure	•In both arms	<ul style="list-style-type: none"> •Takayasu's arteritis •Aortic dissection •Aortic arch syndrome •Subclavian steal syndrome
	•Of upper and lower limbs	• Coarctation of the aorta distal to the left subclavian artery

Diagnostic findings	Underlying condition
<ul style="list-style-type: none">•Day time sleepiness (Epworth scale, Berlin questionnaire)•Nondipping in 24-hour blood pressure monitoring	<ul style="list-style-type: none">•Obstructive sleep apnea

Diagnostic findings	Underlying condition
•Increased 24-hour urinary metanephrines	• Pheochromocytoma

Diagnostic findings	Underlying condition
<ul style="list-style-type: none">• ↑ Serum calcium, ↑ PTH level, ↓ serum phosphates	<ul style="list-style-type: none">• Hyperparathyroidism

Diagnostic findings	Underlying condition
• ↑ Serum cortisol	• Excess of glucocorticoids (e.g ., Cushing syndrome)

Diagnostic findings

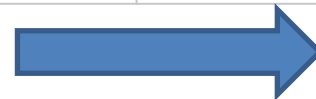
• **↓TSH, ↑ free T4**

Underlying condition

• **Hyperthyroidism**

Nonpharmacologic measures (lifestyle changes)

Intervention	Target	Approximate systolic B P reduction in hypertensive patients
Decrease dietary sodium	•Daily sodium intake < 1500 mg/day	5-6 mm Hg
Increase dietary potassium	•Daily potassium intake < 3.5–5 g	4-5 mm Hg
DASH diet	•Diet rich in fruits, vegetables, whole grains and low in saturated and trans fats	11 mm Hg
Weight loss	•Ideal body weight	1 mm Hg per kg reduction in body weight in overweight individuals



Intervention		Target	Approximate systolic BP reduction in hypertensive patients
Exercise	Aerobic	<ul style="list-style-type: none"> •90 minutes per week •65–75% of maximum heart rate (e.g., brisk walk) 	5–8 mm Hg
	Dynamic resistance (e.g., weight training)	<ul style="list-style-type: none"> •50–80% of maximum strength •90 minutes per week 	4 mm Hg
	Isometric resistance (e.g., hand grip exercise)	<ul style="list-style-type: none"> •30–40% of maximum strength •4 repetitions/session, 3 sessions/week for 8–10 weeks 	5 mm Hg



Intervention	Target	Approximate systolic BP reduction in hypertensive patients
Decreased alcohol intake	<ul style="list-style-type: none"> • ♂ : ≤ 2 drink daily • ♀ : ≤ 1 drink daily 	4 mm Hg
Smoking cessation	• Completely quit smoking	3–5 mm Hg after 1 year; 6–7 mm Hg after 3 years ^[39]



Non-pharmacological measures should be implemented in any patient with a systolic BP > 120 mm Hg or a diastolic BP > 80 mm Hg!

Pharmacologic treatment

Guideline	JNC 8	AHA/ACC 2017
Indication for pharmacological therapy	<ul style="list-style-type: none">•Adults without diabetes mellitus or chronic kidney disease<ul style="list-style-type: none">• Age ≥ 60 years: BP ≥ 150/90 mm Hg• Age < 60 years: BP ≥ 140/90 mm Hg•Adults with diabetes mellitus and/or chronic kidney disease: ≥ 140/90 mm Hg	<ul style="list-style-type: none">•BP ≥ 140/90 mm Hg•BP ≥ 130/80 mm Hg with a 10-year-risk of cardiovascular death ≥ 10% (e.g., patients with age ≥ 65 years, diabetes mellitus, chronic kidney disease, heart failure, stable ischemic heart disease, peripheral artery disease, and/or previous stroke)



Guideline	JNC 8	AHA/ACC 2017
Treatment goal	•BP less than threshold for initiating pharmacological therapy	•Age < 65: BP < 130/80 mm Hg

Specific recommendations

- Initial treatment (including those with diabetes): treatment should include a thiazide-type diuretic, calcium channel blocker (CCB), angiotensin-converting enzyme inhibitor (ACE-I), **or** angiotensin receptor blocker (ARB)
- In adults with chronic kidney disease, initial (or add-on) treatment should include an ACE inhibitor or ARB to improve kidney outcome.

Initiation of treatment and follow-up

1. Number of antihypertensives

- Newly diagnosed hypertension with BP < 150/90 mm Hg: begin therapy with one primary antihypertensive
- Newly diagnosed hypertension with BP > 150/90 mm Hg: begin therapy with two primary antihypertensives

2. Reassess within one month of initiating or changing pharmacological therapy.
 - If treatment goal is not reached with one drug:
Increase the dose of the initial drug or add a second drug
 - If treatment goal cannot be reached with two drugs
 - Add a third drug.
 - Evaluate for secondary causes of hypertension
 - If blood pressure is controlled: reassess after 3–6 months and annually thereafter

Overview of antihypertensive drugs

Drug class	Comments	Side effects
Primary drugs		
ACE inhibitors (e.g., lisinopril, captopril, enalapril)	<ul style="list-style-type: none"> • Preferred as a first-line drug among patients with diabetes mellitus, renal disease (nephroprotective), ischemic heart disease, and heart failure 	<ul style="list-style-type: none"> • Dry cough, angioedema • $\uparrow K^+$ • Teratogenic
Angiotensin-receptor blockers (ARB) (e.g., losartan, valsartan)	<ul style="list-style-type: none"> • ACEi and ARBs should not be used in combination 	<ul style="list-style-type: none"> • $\uparrow K^+$ • Teratogenic

Drug class	Comments	Side effects
Primary drugs		
<p style="text-align: center;">Thiazide diuretics (e.g., hydrochlorothiazide, chlorthalidone)</p>	<ul style="list-style-type: none"> • Preferred as a first-line drug among African Americans, salt-sensitive patients, and patients with isolated systolic hypertension 	<ul style="list-style-type: none"> • ↓ K⁺, ↓ Na • ↑ Glucose and cholesterol

Drug class	Comments	Side effects
Primary drugs		
Calcium channel blockers	Dihydropyridines (e.g., nifedipine, amlodipine)	<ul style="list-style-type: none"> • Preferred as a first-line drug among African Americans and patients with isolated systolic hypertension • Non-dihydropyridines are not commonly used • Non-dihydropyridines are contraindicated in patients with reduced ejection fraction <ul style="list-style-type: none"> • Headache • Constipation • Gastroesophageal reflux • Pedal edema • Bradycardia (non-dihydropyridines)
	Non-dihydropyridines (e.g., diltiazem, verapamil)	

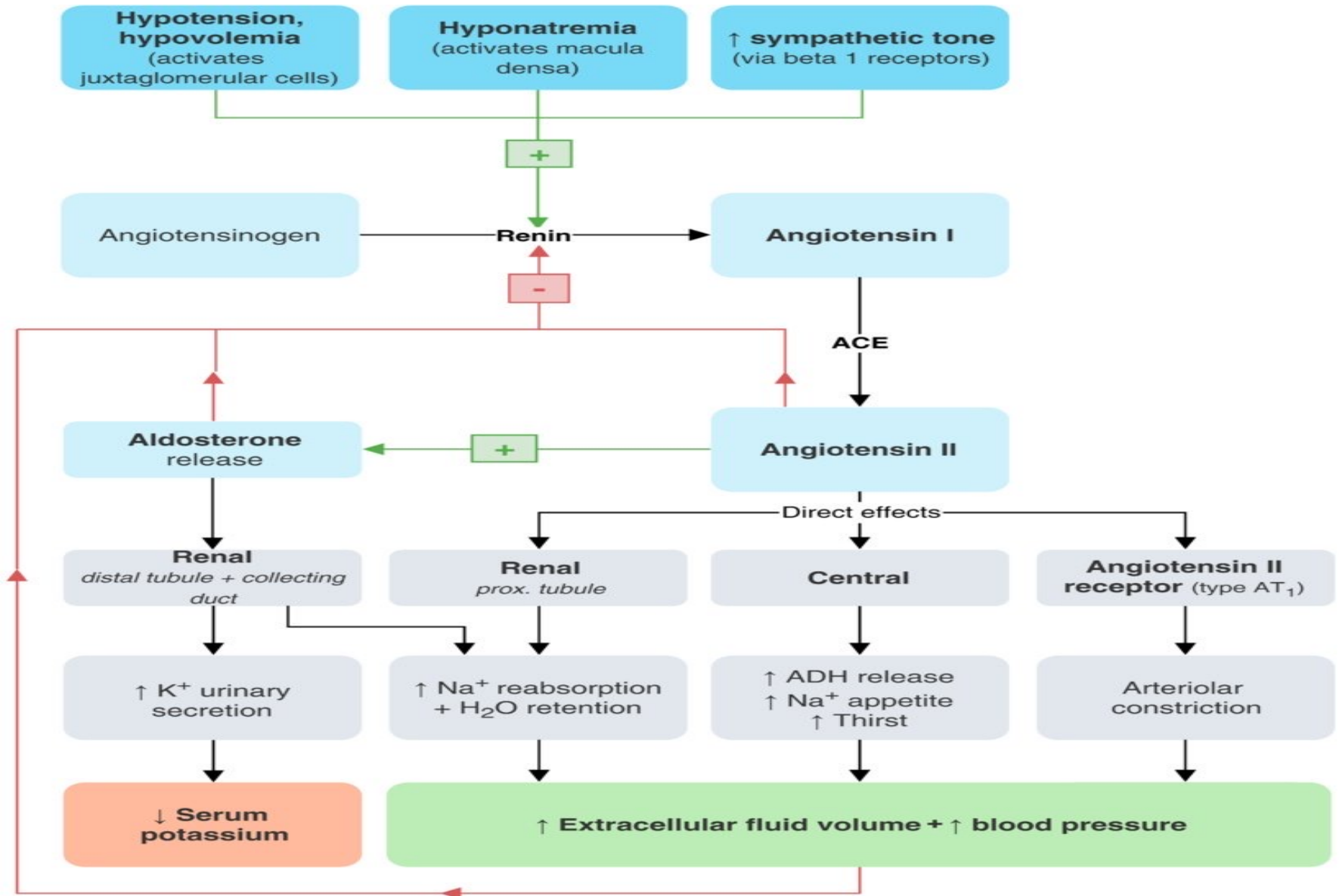
Drug class	Comments	Side effects
Secondary drugs		
<p>Beta blockers (e.g., propranolol, metoprolol, labetalol)</p>	<ul style="list-style-type: none"> • Should be avoided in hypertension due to aortic regurgitation • Often used as a primary drug in patients with any of the following co-morbidities: <ul style="list-style-type: none"> • Ischemic heart disease • Heart failure • Atrial fibrillation • Thoracic aortic disease (e.g., dissection, aneurysm) • Thyrotoxicosis • Migraine • Essential tremor 	<ul style="list-style-type: none"> • Bronchoconstriction with non-cardioselective beta blockers • Increased triglycerides

Drug class	Comments	Side effects
Secondary drugs		
<p>Aldosterone antagonists (e.g., eplerenone, spironolactone)</p>	<ul style="list-style-type: none"> • Used in hypertension due to primary aldosteronism • Can be used as add-on therapy in resistant hypertension 	<ul style="list-style-type: none"> • ↑ K⁺ • Gynecomastia (spironolactone)

Drug class	Comments	Side effects
Secondary drugs		
Direct renin inhibitors (e.g., aliskiren)	<ul style="list-style-type: none"> • Should not be used in combination with ACEi or ARBs 	<ul style="list-style-type: none"> • ↑ K⁺
Alpha-1 blockers (e.g., prazosin, doxazosin)	<ul style="list-style-type: none"> • Used in hypertension due to pheochromocytoma • May be used as an adjunct in patients with benign prostatic hypertrophy 	<ul style="list-style-type: none"> • Postural hypotension • Headache

Drug class	Comments	Side effects
Secondary drugs		
Alpha-2 agonists (e.g., clonidine)	<ul style="list-style-type: none"> • Rarely used 	<ul style="list-style-type: none"> • CNS depression • Bradycardia • Rebound hypertension
Direct arteriolar vasodilators (e.g., hydralazine)	<ul style="list-style-type: none"> • Hydralazine is a first-line treatment in pregnancy • Sodium nitroprusside is used only in hypertensive emergencies 	<ul style="list-style-type: none"> • Reflex tachycardia • Sodium and water retention • Cyanide toxicity with long-term use of sodium nitroprusside

Inhibition of the renin-angiotensin-aldosterone system



Pharmacologic treatment in pregnancy

First-line treatment:

methyldopa , labetalol, hydralazine (vasodilator)
, and nifedipine (CCB)

Second-line treatment:

thiazides, clonidine (a₂-agonist)

Contraindicated:

furosemide, ACE-I, ARB, renin inhibitors
(aliskiren)

Complications

Arterial hypertension leads to changes in the vascular endothelium, particularly of the small vessels, and can therefore affect any organ system.

Cardiovascular system

- **Congestive heart failure**, dilated cardiomyopathy, **hypertrophic cardiomyopathy**
- Coronary artery disease and **myocardial infarction**
- Atrial fibrillation
- Aortic aneurysm
- **Aortic dissection**
- **Carotid artery stenosis**
- Peripheral artery disease

Brain

- **Stroke** , TIA
- Cognitive changes such as memory loss

Kidneys

- **Hypertensive nephrosclerosis**

- Pathophysiology: chronic hypertension → **narrowing of afferent and efferent arterioles** → reduction of glomerular blood flow → glomerular and tubular ischemia → **arteriolonephrosclerosis** and fibrosis (focal segmental glomerulosclerosis) → end-stage renal disease
- Typical findings
 - Initially **microalbuminuria** and microhematuria
 - With disease progression, **nephrosclerosis** with **macroalbuminuria** (usually < 1 g/day) and progressive renal failure occur
 - Biopsy: **sclerosis in capillary tufts, arterial hyalinosis**

Eyes

- **Hypertensive retinopathy**
 - Arteriosclerotic and hypertension-related changes of the retinal vessels
 - Fundoscopic examination: **cotton-wool spots, retinal hemorrhages** (i.e., **flame-shaped hemorrhages**), **arteriovenous nicking** , marked swelling and prominence of the optic disk with indistinct borders due to **papilledema** and optic atrophy (end-stage disease)



Local treatment of the eye is not possible; therefore, systemic reduction of blood pressure is critical!

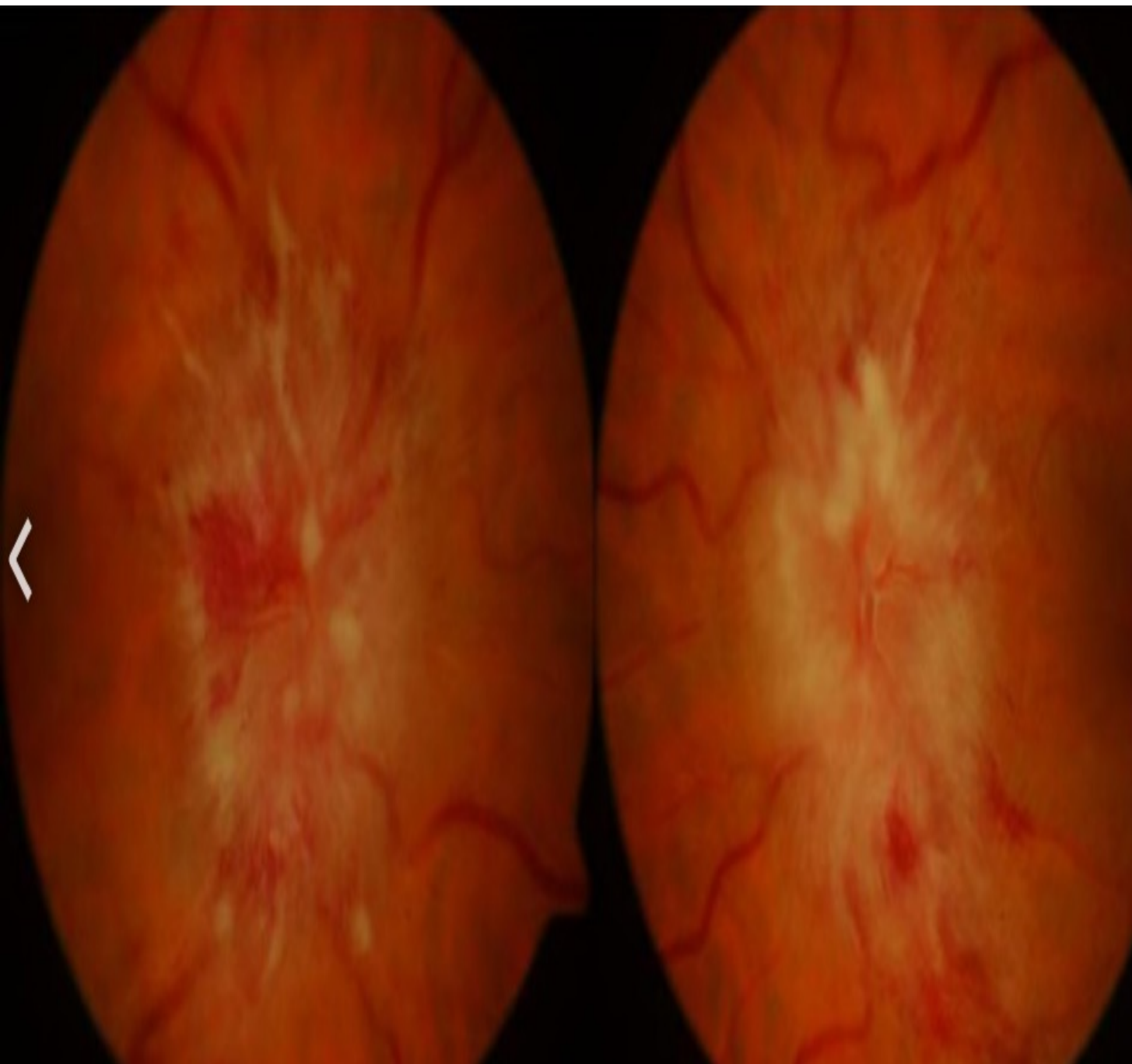
Grade IV hypertensive retinopathy

Fundoscopic image of the right eye

There are hard exudates (green overlay), narrow arterioles, and a retinal hemorrhage in close proximity to the papilla (hatched overlay). The papilla has irregular borders, which is consistent with a diagnosis of papilledema.

These findings are consistent with grade IV hypertensive retinopathy.





Bilateral papilledema

Fundoscopic images of both eyes

Optic discs are elevated and have blurred margins. Furthermore, cotton wool spots (examples indicated by white overlay), tortuous veins, and multiple hemorrhages (indicated by red overlay) are visible.

These findings are typical of bilateral papilledema in hypertensive retinopathy.

Hypertensive crisis (acute severe hypertension)

Definition: acute increase in blood pressure >
180/120 mm Hg

Classification

- **Hypertensive urgency:** acute increase in blood pressure **without symptoms** and with **no signs of organ damage**
- **Hypertensive emergency:** severely increased BP with signs of **end-organ damage** (mainly in the **cardiovascular, central nervous,** and **renal** system)



- Cardiac presentation (**chest pain, dyspnea**) Pulmonary edema
- **Myocardial infarction**
- Congestive heart failure and dilated cardiomyopathy
- **Aortic dissection**



- Neurologic presentation
(**headache, confusion, blurry vision**)**Hypertensive encephalopathy**
- Ischemic or **hemorrhagic stroke**
- **Malignant hypertension:** severe hypertension that occurs with **retinopathy (flame hemorrhages, papilledema)**



- **Renal presentation:**

azotemia and/or oliguria due to **acute renal failure**

Treatment

- **Hypertensive urgency**

Reinstitute or increase dosage of oral antihypertensive therapy



- **Hypertensive emergency**

ICU admission and immediate initiation of intravenous antihypertensive therapy



Rate of blood pressure reduction

- **General goal**
 - Reduce BP by **max. 25%** within the **first hour** to prevent coronary insufficiency and to ensure **adequate cerebral perfusion!**
 - Reduce BP to 160/100–110 mm Hg over next 2–6 hours
 - Reduce BP to normal over 24–48 hours



In summary, blood pressure management is crucial in both intracerebral hemorrhage and acute ischemic stroke. To optimize best results, intensivists should aim to keep systolic blood pressure in intracranial hemorrhage below 140 mm Hg. In acute ischemic stroke, treatment is recommended for blood pressure above 220/110 if no intervention of thrombolytics is planned (in first 24hr post ischemic stroke). For patients eligible for intravenous alteplase therapy, maintaining a goal of <185/110 prior to thrombolytic therapy and below 180/105 after thrombolytic therapy or in cases of thrombectomy is recommended by guidelines. If blood pressure is above 220/110 mm Hg, a reduction of approximately 15% (but no more than 25%) over the first 24 hours is suggested, with gradual reduction thereafter to reach target as in regular HTN guidelines.

Special cases

- Severe pre-eclampsia
/eclampsia or pheochromocytoma:
- systolic BP < 140 mm Hg within the first hour



- Aortic dissection: systolic BP < 120 mm Hg within 20 minutes



- **Acute stroke:**
- Acute ischemic / intracerebral hemorrhage stroke
 - If the patient qualifies for thrombolytic therapy
 - Systolic BP < 185 mm Hg and diastolic BP < 110 mm Hg before thrombolysis
 - BP < 180/105 mm Hg for the first 24 hours after thrombolysis
 - If the patient does not qualify for thrombolytic therapy
 - BP ≤ 220/110 mm Hg: DO NOT lower BP during the first 48–72 hours
 - BP > 220/110 mm Hg: lower BP by 15% in the first 24 hours

Choice of intravenous antihypertensive drug

The selection of an intravenous antihypertensive and its dosing is based on the desired rate of BP decrease, the presence or absence of certain co-morbidities, and the drug's pharmacodynamic properties

Associated co-morbidity	Preferred intravenous antihypertensive	Comments
Aortic dissection	<ul style="list-style-type: none">• First-line: esmolol or labetalol• Second-line (as an adjunct): nitroprusside or nicardipine	<ul style="list-style-type: none">• Beta blockers should precede administration of vasodilators (e.g., nicardipine, nitroprusside)



Associated co-morbidity	Preferred intravenous antihypertensive	Comments
Pulmonary edema	<ul style="list-style-type: none"> • Clevidipine • Nitroprusside • Nitroglycerin 	<ul style="list-style-type: none"> • Nitroglycerin is contraindicated if the patient had received a phosphodiesterase inhibitor (e.g., sildenafil, tadalafil) within the past 48 hours • Beta blockers are contraindicated if the patient has pulmonary edema, bradycardia, 2nd/3rd degree heart block, or cardiogenic shock
Acute coronary syndrome	<ul style="list-style-type: none"> • Nitroglycerin • Esmolol • Labetalol • Nicardipine 	



Associated co-morbidity	Preferred intravenous antihypertensive	Comments
Acute renal failure	<ul style="list-style-type: none">• Clevidipine• Nicardipine• Fenoldopam	<ul style="list-style-type: none">• Nitroprusside and esmolol should be avoided



Associated co-morbidity	Preferred intravenous antihypertensive	Comments
Catecholamine excess	<ul style="list-style-type: none">• Clevidipine• Nicardipine• Phentolamine	<ul style="list-style-type: none">• Beta blockers should be avoided



Associated co-morbidity	Preferred intravenous antihypertensive	Comments
Acute ischemic stroke	<ul style="list-style-type: none"> • Labetalol • Clevidipine • Nicardipine 	<ul style="list-style-type: none"> • Fenoldopam, nitroglycerin, and nitroglycerin should be avoided
Acute intracerebral hemorrhage		



Associated co-morbidity	Preferred intravenous antihypertensive	Comments
Eclampsia/severe pre-eclampsia	<ul style="list-style-type: none">• Hydralazine• Labetalol• Nicardipine	<ul style="list-style-type: none">• Nitroprusside is contraindicated

Intravenous antihypertensives

- Calcium channel blocker: nicardipine, clevidipine
- Nitric-oxide dependent vasodilators: sodium nitroprusside, nitroglycerin
- Direct arterial vasodilators: hydralazine
- Anti-adrenergic drugs
 - Selective beta-1 blocker: esmolol
 - Non-selective beta blocker with alpha-1 antagonism: labetalol
 - Non-selective alpha blocker: phentolamine
- D1 agonist: fenoldopam



The most commonly used drugs to treat hypertensive emergency are nitroprusside, labetalol, and nicardipine.

Update in hypertension therapy (AHA-December 28/12/2023):

Novel Antihypertensive May Boost Medication compliance. Fewer than 25% of adults being treated for hypertension keep their blood pressure (BP) within the target range, often due to low compliance with daily oral medication. Zilebesiran, an investigational, subcutaneously administered RNA interference therapeutic targeting angiotensinogen drug, has the potential to change that. In the phase 2 KARDIA-1 study, a single injection of zilebesiran effectively lowered BP in adults with hypertension for up to 6 months, with an encouraging side-effect profile. It is a SQ injection every 3-6 months to control BP!! Zilebesiran, has the potential to control BP.