Cardiovascular system

Hypertension (High Blood Pressure)

Introduction / Epidemiology

- Hypertension (HTN) is defined as persistently elevated arterial blood pressure.
- According to **2020 ISH and 2017**
    - **ACC/AHA guidelines**:
    - **Normal BP:** <120/80 mmHg
    - **Elevated BP:** 120–129/<80 mmHg
    - **Stage 1 HTN:** 130–139 systolic or 80–89 diastolic mmHg
    - **Stage 2 HTN:** ≥140 systolic or ≥90 diastolic mmHg

Epidemiology:

- Affects **~1.28 billion** people worldwide (WHO 2021).
- Leading **modifiable risk factor** for CVD, stroke, renal disease.
- Prevalence increases with **age**, more common in **males** <60 years, then in **females** >60 years.
- High in **low- and middle-income countries** due to poor diagnosis and control.
- Only **~20%** of hypertensives have controlled BP.

Etiopathogenesis

Primary (Essential) Hypertension – ~90–95%:

- No identifiable cause; multifactorial.
- Contributing factors:
    - Genetic predisposition (e.g., polymorphisms in RAAS genes)
    - Overactivation of **renin-angiotensin-aldosterone system (RAAS)**
    - Sympathetic nervous system hyperactivity
    - Sodium retention
    - Obesity, insulin resistance
    - Environmental (salt intake, stress, sedentary lifestyle)

Secondary Hypertension – ~5–10%:

- Identifiable cause:
    - **Renal** (e.g., CKD, renal artery stenosis)
    - **Endocrine** (e.g., primary aldosteronism, pheochromocytoma, Cushing's)

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- **Vascular** (e.g., coarctation of aorta)
- **Drugs** (NSAIDs, corticosteroids, oral contraceptives)
- **OSA (Obstructive Sleep Apnea)**

Clinical Features / Symptoms

Often asymptomatic ("Silent killer")

When present:

- Headache (esp. occipital, morning)
- Dizziness, fatigue
- Palpitations
- Epistaxis
- Blurred vision
- Symptoms due to end-organ damage:
  - Chest pain (cardiac ischemia)
  - Dyspnea (CHF)
  - Hematuria (renal involvement)
  - Neurological symptoms (stroke, TIA)

Diagnosis & Investigations

Diagnosis:

1. Based on **2–3 elevated readings** on **different occasions**.
2. Use validated **automated BP devices**.
3. Measure in both arms, after 5 minutes rest, seated, proper cuff size.

Investigations:

Basic work-up (for all):

- CBC
- Fasting blood glucose / HbA1c
- Lipid profile
- Serum creatinine, eGFR
- Serum electrolytes (K+, Na+)
- Urinalysis (proteinuria, RBCs)
- ECG
- Optional: echocardiogram (LVH), fundus exam (retinopathy)

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Secondary HTN work-up (if suspected):

- Renal Doppler USG
- Plasma aldosterone-renin ratio (ARR)
- 24-hour urine catecholamines/metanephrines
- Thyroid profile
- Sleep study (for OSA)

Treatment Goals / Therapeutic Objectives

- Reduce BP to **target level** to minimize risk of cardiovascular events and organ damage.
- **BP Targets:**
  - <140/90 mmHg for most
  - <130/80 mmHg in patients with **diabetes, CKD, CAD, stroke**
  - 65 years: <140–150/90 (avoid hypotension)
- **Long-term goals:**
  - Prevent MI, stroke, heart failure, CKD
  - Reverse LVH
  - Improve quality of life

Non-Pharmacological Therapy

- **Lifestyle modifications – cornerstone for all stages**:
  - **DASH diet:** Rich in fruits, vegetables, low-fat dairy; reduced saturated fats
  - **Salt restriction:** <5g/day sodium (~2g Na^+)
  - **Weight reduction:** BMI <25 kg/m^2
  - **Physical activity:** 150 min/week moderate exercise
  - **Alcohol moderation:** <2 drinks/day (men), <1 drink/day (women)
  - **Smoking cessation**
  - **Stress management:** Yoga, meditation
- Can reduce SBP by 4–11 mmHg depending on intervention.

Pharmacological Therapy

First-line Drugs

- (as per ACC/AHA, ESC, ISH guidelines):
  - Thiazide diuretics (e.g., hydrochlorothiazide, chlorthalidone)
  - ACE inhibitors (e.g., enalapril, ramipril)

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- ARBs (e.g., losartan, telmisartan)
- Calcium channel blockers (CCBs) (e.g., amlodipine, nifedipine)

➢ Use combination therapy for stage 2 HTN or initial BP >20/10 mmHg above target.

Alternative Drugs:

➢ **Beta-blockers**: Used in CAD, heart failure, arrhythmias.

➢ **Loop diuretics**: In CKD or CHF with edema.

➢ **Alpha-blockers**: Resistant HTN, BPH (e.g., prazosin).

➢ **Centrally acting agents**: (e.g., clonidine, methyldopa – pregnancy)

Drug Details Example (for common agents):

Drug	Dose	Mechanism	Rationale
Amlodipine	5–10 mg OD	Dihydropyridine CCB; vasodilation	Effective in elderly, low renin states
Ramipril	2.5–10 mg OD	ACE inhibition → ↓Ang II	Preferred in diabetics, CKD
Chlorthalidone	12.5–25 mg OD	Inhibits Na-Cl reabsorption in DCT	Long half-life, CV protection
Losartan	50–100 mg OD	ARB, blocks AT1 receptor	Use if ACEI not tolerated (e.g., cough)

Individualized Patient-Specific Therapeutic Plan

- **Age**: Elderly – start low, go slow; avoid orthostatic hypotension.
- **Diabetes**: ACEI/ARB to protect kidneys.
- **CKD**: ACEI/ARB if albuminuria; loop diuretics if volume overload.
- **CAD/MI**: Beta-blockers + ACEI/ARB
- **Pregnancy**: Methyldopa, labetalol, nifedipine
- **African descent**: Better response to CCBs and thiazides
- **Asthma/COPD**: Avoid non-selective beta-blockers
- **Gout**: Avoid thiazides (can increase uric acid)
- **Liver disease**: Avoid centrally acting drugs (e.g., methyldopa – hepatotoxic)

Controversies / Special Considerations

A. BP Targets Debate:

➢ **SPRINT trial (2015)**: Intensive control (<120 mmHg) reduced CV events but increased adverse effects (syncope, AKI).

➢ Recent guidelines (e.g., ESC/ESH 2023) lean towards individualized targets.

B. Choice of first drug:

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- Some debate on superiority of ACEI vs CCB vs thiazides.
- ALLHAT trial showed similar CV outcomes among classes.

C. White-coat & Masked HTN:

- Home/ambulatory BP monitoring essential for accurate diagnosis.

D. Resistant HTN:

- Defined as BP uncontrolled despite 3 drugs (including diuretic).
- Evaluate for secondary causes.

Monitoring Therapy

Clinical Parameters:

- BP (home and office) every 2–4 weeks initially, then every 3–6 months
- Symptom review: dizziness, fatigue, hypotension signs

Laboratory:

- Electrolytes, renal function: 1–2 weeks after starting ACEI/diuretics
- Lipid profile, glucose: Annually or as needed

Response Timeline:

- BP lowering begins in 1–2 weeks, max effect at 4–6 weeks
- Long-term: Monitor for regression of LVH, proteinuria, etc.

Adverse Effects & Management

Drug Class	Adverse Effects	Management
ACEIs	Cough, angioedema, ↑K+, AKI	Switch to ARB; monitor labs
ARBs	Hyperkalemia, dizziness	Monitor K+, adjust dose
Thiazides	HypoK, hypoNa, hyperuricemia	K+ supplements, monitor labs
CCBs	Pedal edema, headache	Switch to ARB, combine with ACEI
Beta-blockers	Bradycardia, fatigue, ED	Titrate slowly, avoid in asthma

Follow-up and Patient Counseling

Follow-Up:

- Review BP, lab values, lifestyle at each visit
- Reassess drug response every 2–4 weeks
- Annual ECG, eye exam, urine microalbumin

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