Hypertension
Hypertension: Definition

- Hypertension is a hemodynamic disorder
- A well accepted definition of hypertension was suggested by Evans and Rose:
  
  "Hypertension should be defined in the terms of blood pressure level above which investigation and treatment do good more than harm"

- A patient is said to be hypertensive when his SBP ≥ 140 mm Hg & DBP ≥ 90 mm Hg provided that the patient is not on antihypertensive drugs.
Epidemiology

- 6% of deaths worldwide
- Defined as any of the following: systolic blood pressure $\geq 140$ mmHg, diastolic blood pressure $\geq 90$ mmHg, taking antihypertensive medications
- Pulse pressure = the difference between systolic and diastolic blood pressure
- Widening of pulse pressure beyond age 60
- USA: 58 million individuals with hypertension
- Individuals aged $\geq 60$, hypertension prevalence 65%
Epidemiology 2

- Environmental and genetic factors
- Obesity, weight gain
- Dietary NaCl intake
- Alcohol consumption
- Stress
- Low levels of physical activity
- Genetic factors
<table>
<thead>
<tr>
<th>Category</th>
<th>Systolic</th>
<th>Diastolic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>&lt; 120</td>
<td>and &lt; 80</td>
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<tr>
<td>Prehypertension</td>
<td>120-139</td>
<td>or 80-89</td>
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**High Blood Pressure/Hypertension**

| Stage 1 Hypertension   | 140-159       | or 90-99     |
| Stage 2 Hypertension   | ≥ 160          | or ≥ 100     |
Mechanisms of Hypertension

- Determinants of arterial pressure:
  1. Cardiac output: Stroke volume (myocardial contractility) + Heart rate
  2. Peripheral resistance: Vascular structure + Vascular function in small arteries and arterioles

- Renin-angiotensin-aldosterone system: regulation of arterial pressure
Pathologic consequences of Hypertension

1. Heart
   - Hypertensive heart disease
   - Left ventricular hypertrophy and diastolic dysfunction
   - Chronic heart failure
   - Atherosclerotic coronary artery disease and microvascular disease
   - Cardiac arrhythmias
Pathologic consequences of Hypertension

2. Brain

- Brain infarction and hemorrhage
- Stroke
- Cognitive impairment and dementia
- Hypertensive encephalopathy
Pathologic consequences of Hypertension

3. Kidney
- Renal injury, ischemic changes in the glomeruli
- Glomerulosclerosis
- Micro- or macroalbuminuria

4. Peripheral arteries
- Atherosclerotic disease
- Intermittent claudication
Evaluation of hypertensive patients

Evaluation by

- Medical history
- Physical Examination
- Laboratory investigation
  - Routine tests
  - Optional tests.
Defining Hypertension

- Normal: Systolic <120 mmHg, Diastolic <80 mmHg
- Prehypertension: Systolic 120-139 mmHg, Diastolic 80-89 mmHg
- Stage 1 hypertension: Systolic 140-159 mmHg, Diastolic 90-99 mmHg
- Stage 2 hypertension: Systolic ≥160 mmHg, Diastolic ≥100 mmHg
- Isolated systolic hypertension: Systolic ≥140 mmHg, Diastolic <90 mmHg
Defining Hypertension 2

- Average of 2 or more seated blood pressure reading during each of 2 or more outpatient visits
- Home blood pressure measurement
- 24-h ambulatory blood pressure measurement
- Blood pressure higher in the early morning hours
- Nighttime blood pressure 10-20% lower
- White coat hypertension
Systolic hypertension with wide pulse pressure

1. Decreased vascular compliance (arteriosclerosis)
2. Increased cardiac output
   a. Aortic regurgitation
   b. Thyrotoxicosis
   c. Hyperkinetic heart syndrome
   d. Fever
   e. Arteriovenous fistula
   f. Patent ductus arteriosus
Causes of Hypertension

Secondary Hypertension
- Develops through the manifestation of other medical problems
- Occurs in about 5% of the population

Essential, Primary or Idiopathic Hypertension
- No definitive causes
- Multiple risk factors
- Present in 95% of the population

- Renal problems
- Genetic
- Vascular problems
- Alcohol
- Stress
- Obesity
- Over the counter Medications

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Aetiology of Systemic Hypertension

B) Secondary HTN (05%)

A. Renal (80%)
- AGN
- CGN,
- CPN,
- Polycyst. K.D
- Renal Artery stenosis

B. Endocrine
- Adrenal
  - Primary aldosteronism
  - Cushing’s syndrome
  - Pheochromocytoma
- Acromegaly
- Exogenous hormone
  - Oral contraceptive
  - Glucocorticoids
- Hypothyroidism &
  - Hyperparathyroidism

Continue...
Secondary causes of Hypertension

- Renal: Glomerular diseases, chronic renal failure, nephrosclerosis, polycystic kidney disease, renin-secreting renal tumors, obstructive uropathy
- Renovascular: Arteriosclerotic, fibromuscular dysplasia of a renal artery with abdominal bruit. Percutaneous transluminal renal angioplasty and placement of a vascular endoprosthesis (stent)
- Adrenal: Primary aldosteronism, Cushing’s syndrome, pheochromocytoma
- Aortic coarctation: diminished femoral pulses
Secondary causes of Hypertension

2.

- Obstructive sleep apnea
- Preeclampsia/eclampsia
- Neurogenic: acute increased intracranial pressure, acute spinal cord section, diencephalic syndrome
- Miscellaneous endocrine: hyperthyroidism, hypercalcemia, acromegaly
- Medications: high-dose estrogens, steroids, cyclospoine, tricyclic antidepressants, erythropoietin
Essential Hypertension

- Essential hypertension: 80-95% = primary or idiopathic hypertension
- Familial
- Environmental and genetic factors
- Abdominal obesity, dyslipidemia, insulin resistance = metabolic syndrome
- Lack of physical activity
Primary aldosteronism

- Hypokalemia
- Plasma aldosterone: plasma renin activity
- Aldosterone-producing adrenal adenoma unilaterally, <3 cm in diameter or bilateral adrenocortical hyperplasia or aldosterone-producing carcinoma
- Dg: adrenal CT or MRI
Cushing’s syndrome

- Plasma cortisol
- 24-h excretion rate of urine free cortisol
- Late night salivary cortisol
Pheochromocytoma

- Catecholamine-secreting tumor
- Adrenal medulla
Patient’s relevant history

- Duration of hypertension
- Previous therapies: responses and side effects
- Family history of hypertension and cardiovascular disease
- Dietary and psychosocial history
- Other risk factors: weight change, dyslipidemia, smoking, diabetes, physical inactivity
Patient’s relevant history 2.

- Evidence of secondary hypertension: history of renal disease, change in appearance, muscle weakness, sweating, palpitations, tremor, erratic sleep, snoring, daytime somnolence, symptoms of hyperthyroidism, use of agents that may increase blood pressure
- Evidence of target organ damage: history of TIA, stroke, transient blindness, angina, myocardial infarction, congestive heart failure
Approach to the patient: Hypertension

- History: headache localized to the occipital region, dizziness, palpitations, easy fatigability
Measurement of blood pressure

- Aneroid instruments
- Accuracy confirmed
- Sitting position
- The cuff at heart level
- Width of the bladder cuff equal at least 40% of the arm circumference
- Pay attention to cuff placement, stethoscope placement, and the rate of deflation of the cuff
Measurement of blood pressure 2.

- Systolic blood pressure: the first of Korotkoff sounds
- Diastolic blood pressure: the last regular Korotkoff sound heard
- Fully automated ambulatory monitors
Physical examination

- Body weight and height
- Blood pressure measured in both arms in the supine, sitting, and standing positions
- Palpation of femoral pulse
- Arterial pressure measured in the lower extremity
- Heart rate, loud second heart sound at the aortic valve
- Apical impulse enlarged, sustained and laterally displaced → left ventricular hypertrophy
- Auscultation for bruises over the carotid and femoral arteries
- Abdominal bruit
- Palpability of kidney
Basic laboratory tests

- Renal: microscopic urinalysis, albumin excretion, serum BUN, creatinine
- Endocrine: serum sodium, potassium, calcium, (TSH)
- Metabolic: fasting blood glucose, total cholesterol, triglycerides
- Other: hematocrit, electrocardiogram
Complications of Hypertension

**Brain Stroke**
Reduced blood supply to the brain can lead to rapid loss of brain function or stroke.

**Vision Loss**
Hypertensive Retinopathy
High blood pressure can damage blood vessels in the retina, resulting in loss of vision.

**Blood Vessel Damage**
Atherosclerosis
Hypertension is a leading cause of atherosclerosis, the artery-narrowing process that can result in heart attack and stroke.

**Heart Attack**
Hypertension causes the heart to pump against high blood pressure, making it work harder than necessary. Over time, this causes the heart muscle to thicken, restricting blood flow which can lead to heart failure.

**Kidney Failure**
Damaged blood vessels in the kidneys can't effectively filter your blood, resulting in a dangerous accumulation of fluid and waste.

**Bone Loss**
High blood pressure may increase the amount of calcium in your urine. That excessive elimination of calcium may lead to loss of bone density (osteoporosis).
Pre-hypertension

Established hypertension

Proteinuria

Nephrosclerosis

Chronic renal failure

End-stage renal disease

Arterial fibrillation

Ventricular arrhythmias

Ventricular tachycardia/fibrillation

Systolic/diastolic dysfunction

Congestive heart failure

Coronary artery disease

Angina

Myocardial infarction

Retinopathy

Binswanger lesions

Dementia

Transient ischemic attack

Stroke

Asymptomatic

Oglosymptomatic

Symptomatic

Polysymptomatic or end-stage disease

DEATH
Treatment of Hypertension
Lifestyle modifications to manage hypertension

- Weight reductions
- Dietary salt reduction: < 6 g NaCl/d
- Diet rich in fruits, vegetables, and low-fat dairy products with reduced content of saturated and total fat
- Moderation of alcohol consumption
- Physical activity e.g. brisk walking for 30 min/d
Pharmacologic therapy

- Drug therapy recommended: blood pressure $\geq 140/90$ mmHg
Diuretics

- **Thiazides:** Hydrochlorothiazide, Chlortalidone
- **Loop diuretics:** Furosemide, Ethacrynic acid
- **Aldosterone antagonists:** Spironolactone
- **K⁺ retaining:** Amiloride, Triamterene

**Side effects**
Blockers of the Renin-Angiotensin System = ACE inhibitors

- Captopril, Lisinopril, Ramipril
- Side effects
Angiotensin II Receptor Blockers = ARBs

- Losartan, Valsartan, Candesartan
- Side effects
Beta Blockers

- Cardioselective: Atenolol, Metoprolol
- Nonselective: Propranolol
- Combined alpha/beta: Labetalol, Carvedilol
- Side effects
α-Adrenergic Blockers

- Selective: Prazosin, Doxazosin
- Nonselective: Phenoxybenzamine
Central Sympatholytic Agents

- Clonidine, Methyldopa, Reserpine, Guanfacine
Calcium Channel Blockers

- Nifedipine, Verapamil, Diltiazem
- Side effects
Direct Vasodilators

- Hydralazine, Minoxidil
Usage

- Monotherapy
- Combined therapy
Hypertensive emergencies

- Malignant hypertension: Labetalol iv., Nicardipine iv., Nitroprusside iv., Enalapril
- Reduce blood pressure no more than 25%