Hypertension

Definition: Hypertension (HTN or HT), also known as high blood pressure or arterial hypertension; is a chronic condition in which the blood pressure (BP) in the arteries is persistently elevated.

Normal Regulation of Blood Pressure:

- Arterial blood pressure is directly proportionate to the product of the blood flow (cardiac output; CO) and the resistance to passage of blood through arterioles (peripheral vascular resistance; PVR), i.e. BP: is a pressure generated when the heart pumps the blood against the resistance of arterioles.

BP = Cardiac Output (CO) X Peripheral Vascular Resistance (PVR)

Cardiac Output (CO): CO= Stroke Volume(SV) X Heart Rate(HR)

Stroke Volume (SV): is the volume of blood pumped from the left ventricle of the heart per beat.

Heart Rate (HR): is the speed of the heartbeat measured by the number of poundings of the heart per unit of time (typically beats per minute).

- Increase CO or PVR, or both Increase BP.

- Decrease CO or PVR, or both Decrease BP.

- In both normal and hypertensive individuals , BP is maintained by moment-to-moment regulation of CO and PVR, through;
  - Neural Mechanisms : baroreceptors and autonomic nervous system .
  - Renal Mechanisms : renin-angiotensin-aldosterone system and aldosterone.
  - Local Endothelium Derived Factors : nitric oxide (vasodilator) and endothelin (vasoconstrictor).
  - Other Hormones : e.g.; natriuretic peptides, vasopressin & kallikrein-Kinin system.

Uncontrolled Hypertension Effects on the Body:

Arteries Damage - Artery walls thick and stiff (arteriosclerosis)

- Cause, angina (chest pain), heart attack, heart failure, kidney failure, stroke, blocked arteries in legs or arms (peripheral artery disease) and eye damage.

Heart Damage - Uncontrolled high blood pressure can damage the heart in a number of ways, such as coronary artery disease, enlarged left heart (left ventricular hypertrophy) and heart failure (heart muscle weakness and work less efficiently).

Kidneys Damage - Uncontrolled high blood pressure can injure renal blood vessels and leading nephropathy

- Cause, weakens and damages the artery wall lead to kidney failure.

- Diabetes in addition to high blood pressure can worsen the damage.

Eye Damage - Cause, Hypertensive Retinopathy:

- Damage in the arterial and arteriolar circulation in response to the high blood pressure.

Brain Damage - Stroke , due to damaging and weakening brain blood vessels.

- Dementia ; due to narrowing and blockage of the arteries that supply blood to the brain

Some of Medical Terms:-

- **Systolic Blood Pressure (SBP):** is the top number, the highest pressure when the heart pushes the blood into the body.
- **Diastolic Blood Pressure (DBP):** is the bottom number, the lowest pressure when the heart relaxes between beats.
- **Mean Arterial Pressure (MAP):** is the average over a cardiac cycle and is determined by the cardiac output , systemic vascular resistance and central venous pressure.

Normal Resting Blood Pressure by Age:

Blood Pressure Value	Male Age (year)			Female Age (year)		
	10-15	20-30	50-60	10-15	20-30	50-60
Systolic blood pressure SBP (mmHg)	100	120	134	84	120	130
Diastolic blood pressure DBP(mmHg)	60	80	84	40	74	84
Mean arterial pressure MAP(mmHg)	73	93	97	55	88	92

classification of hypertension defined by the American Heart Association:-

Blood Pressure Category	Systolic (mm Hg)	Diastolic (mm Hg)	Follow-up
Normal	Less than 120	Less than 80	Recheck once every 2 years
High-normal (Prehypertension)	120-139	80-89	Recheck once every 1 year
Stage 1	140-159	90-99	Confirm within 2 months
Stage 2	160 or higher	100 or higher	Healthcare provider within a month
Hypertensive Crisis	Higher than 180	Higher than 110	Emergency care needed

Classification hypertension defined by cause:-

- Primary (Essential or Idiopathic) Hypertension:
  - The majority of cases about 95%.
  - No specific medical causes.
  - Unknown etiology but multiple factors may contribute to the development of primary hypertension including:
    - Smoking, obesity, stressful lifestyle, high dietary intake of sodium, family story and alcohol intake.
    - Overactive of renin-angiotensin system or sympathetic nervous system.
    - Deficiency in the local synthesis of vasodilating substances (NO, bradykinin and prostacyclin) or excess vasoconstricting substances (angiotensin II and endothelin).
    - Insulin resistance, hyperinsulinemia and obesity, also linked with renin-angiotensin system.
    - Vitamin D deficiency may leads to an increase in renin secretion.
  - Prevalence of essential hypertension increases with age.
- Secondary Hypertension :
  - Few cases about 5%
  - Most of these are caused by:
    1. Chronic kidney disease or renovascular disease .
    2. Primary aldosteronism (Conn's syndrome) & hypercortisolism (Cushing's syndrome).
    3. Pheochromocytoma and hyperthyroidism.
    4. Drugs that may increase BP include:
       - Corticosteroids, Estrogens, NSAIDs and Amphetamines.

Causes of Hypertension :

Nature causes	Chemical causes
- Genetics. - Salt sensitivity. - Obstructive sleep apnea (OSA). - Insulin resistance and hyperinsulinemia. - Stressful situations, obesity, smoking and other lifestyle. - Kidney problems. - Endocrine causes: ❖ Primary aldosteronism. ❖ Pheochromocytoma. ❖ Hyperthyroidism. ❖ Cushing's syndrome.	- Salts. - Alcohol. - Oral contraceptives. - NSAIDs. - Glycyrrhiza glabra (Liquorice). - Decongestants. - Antidepressants. - Sympathomimetics. - Many industrial chemical. - Corticosteroids. - Ergotamine alkaloids. - Cyclosporine (Immunosuppressant drug). - Cocaine. - Caffeine.

Clinical Presentation:-

- Patients with uncomplicated primary hypertension are usually asymptomatic initially.
- Patients with secondary hypertension may have symptoms suggestive of the underly disorder;

  - Pheochromocytoma, sweating , tachycardia and palpitations.

  - Primary aldosteronism; hypokalemia symptoms (muscle cramps & weakness).

  - Cushing's syndrome; weight gain, polyuria, edema, moon face and buffalo hump.

Hypertension Risk Factors:-

- Risk factors that can be controlled are :
  - High cholesterol level.
  - Tobacco use (Smoking).
  - Diabetes mellitus.
  - Overweight and obesity.
  - Physical inactivity.
  - High salt intake.
  - Coarctation of the aorta.
  - Sleep apnea.
- Risk factors beyond our control are:
  - Age.
  - Family history of heart disease.

Diagnose of Hypertension:-

- Diagnosis of hypertension should be based on the average of two or more readings taken at each of two or more clinical encounters.

- Hypertension progress may lead to serious complications, some of clinical diagnosis is needed:

  - Funduscopic examination (examination of the eye).
  - Cardiopulmonary examination.
  - Peripheral vascular examination.
  - Laboratory tests;
    - Plasma electrolytes, hypokalemia may suggest primary aldosteronism.
    - Urine analysis: protein , blood cells and casts in the urine may indicate renovascular disease.
    - Blood urea nitrogen (BUN) to creatinine ratio and glomerular filtration rate (GRF) also be obtained.
    - Lipid profile and blood glucose level.
    - Plasma norepinephrine and urinary metanephrine or vanillylmandelic acid (VMA) level for pheochromocytoma.
    - Plasma and urinary aldosterone level for primary aldosteronism.

Treatment of Hypertension:

Lifestyle Modification (Non-pharmacologic treatment)	Medications (Antihypertensive drugs)
- DASH eating plan (See below). - Dietary sodium (salt) restriction. - Weight loss. - Regular aerobic physical activity. - Smoking cessation. - Moderate alcohol consumption. - Reduction of environmental stressors. * Lifestyle modification alone is effective for most patients with prehypertension, but is insufficient alone for patients with hypertension.	- Diuretics. - B-blockers. - ACE Inhibitors (ACEIs). - Angiotensin receptor blockers (ARBs). - Direct Renin inhibitors. - α-blockers. - Calcium channel blockers (CCBs). - Centrally-acting sympathetic inhibitors. - Peripherally-acting sympathetic inhibitors. - Ganglionic blockers. - Vasodilators. - Antihypertensive of natural sources.

Dietary Approaches to Stop Hypertension (DASH) eating plan:

- Is a diet that is low in; Saturated fats and cholesterol.
- It encourages fewer servings of; Limits sodium (2,300 mg of sodium a day). sweets, sugary beverages and red meats.
- It also includes: Vegetables, fruits, and fat-free or low-fat dairy products.
- It is rich in: Magnesium, potassium, calcium, as well as proteins and fibers.