Systemic hypertension

- Hypertension is defined as average SBP and/or DBP that is greater than or equal to the 95th percentile for sex, age, and height on three or more occasions.

- **Blood pressure** is the product of cardiac output and peripheral vascular resistance
- Nearly half of hypertensive adults had a blood pressure >90th percentile as children
- Children with blood pressure >90th percentile have a **2.4-fold** greater risk of having hypertension as adults.

Secondary hypertension is more common in preadolescent children than in adults

Three separate readings of an elevated blood pressure (greater than 90th percentile for age, height, and sex) on separate visits are needed to make the diagnosis of hypertension.

**Classifications of Hypertension in Children One Year of Age and Older**

- **Normal blood pressure** SBP and DBP less than the 90th percentile
- **Prehypertension** SBP or DBP greater than or equal to 90th percentile but less than 95th percentile
- **Hypertension** SBP or DBP greater than or equal to 95th percentile
  - **Stage 1 hypertension** SBP or DBP from 95th percentile to 99th percentile plus 5 mm Hg
  - **Stage 2 hypertension** SBP or DBP greater than 99th percentile plus 5 mm Hg

**NOTE:** Percentiles are for sex, age, and height for blood pressure measured on at least three separate occasions; if systolic and diastolic percentiles are different, categorize by the higher value.

*SBP = systolic blood pressure; DBP = diastolic blood pressure*

**Conditions associated with hypertension in children**

- **RENNAL**
  1. Chronic pyelonephritis
  2. Hydronephrosis
  3. Congenital dysplastic kidney
  4. Multicystic kidney
  5. Solitary renal cyst
  6. Vesicoureteral reflux nephropathy
  7. Segmental hypoplasia


VASCULAR

- Coarctation of thoracic or abdominal aorta
- Renal artery lesions (stenosis, fibromuscular dysplasia, thrombosis, aneurysm)
- Umbilical artery catheterization with thrombus formation
- Neurofibromatosis (intrinsic or extrinsic narrowing for vascular lumen)
- Renal vein thrombosis
- Vasculitis

ENDOCRINE

1. Hyperthyroidism
2. Hyperparathyroidism
3. Congenital adrenal hyperplasia (11β-hydroxylase and 17-hydroxylase defect)
4. Cushing syndrome
5. Primary aldosteronism

CENTRAL NERVOUS SYSTEM

Intracranial mass
Hemorrhage
Residual following brain injury

Patients with essential hypertension are usually asymptomatic & HPT. is detected during a routine examination; These children may have mild to moderate obesity.

Children with secondary hypertension unless the pressure has been sustained or is rising rapidly, HPT. does not usually produce symptoms. Therefore, clinical manifestations of the underlying disease are the most frequent reasons for detecting HPT.

HPT. may be presented with

- Headache
- Dizziness
- Epistaxis
- Anorexia
- visual changes
seizures may occur in hypertensive encephalopathy which suggested by the presence of vomiting, temperature elevation, ataxia, stupor, and seizures

Physical examination finding Possible etiologies
* Abdominal bruit = Renal artery stenosis
* Abdominal mass = Polycystic kidney disease; hydronephrosis/obstructive renal lesions; neuroblastoma; Wilms’ tumor
* Moon facies, Acne, Hirsutism Obesuty (of the face, neck, or trunk) = Cushing’s syndrome
* Adenotonsillar hypertrophy = Sleep disorder associated with hypertension
* Murmur, Decreased perfusion of lower extremities = Coarctation of the aorta
* Diaphoresis, Flushing = Pheochromocytoma
* Growth retardation = Chronic renal failure
* Malar rash, Joint swelling = SLE
* Muscle weakness = Hyperaldosteronism
* Obesity (general) Association with primary hypertension
* Tachycardia = Hyperthyroidism; pheochromocytoma; neuroblastoma

Laboratory Tests for the child with Hypertension
To identify cause
- Complete blood count Rule out anemia consistent with chronic renal disease
- Electrolytes, blood urea nitrogen, creatinine, calcium, phosphorus, uric acid
- Renal ultrasound to Rule out renal scarring; congenital renal anomalies; unequal renal size, Rule out renal disease, calculi; chronic pyelonephritis
- Urinalysis, urine culture Rule out infection; hematuria; proteinuria
- Fasting lipid panel, fasting glucose.

To identify end-organ damage
Echocardiography Identify left ventricular hypertrophy
Retinal examination Identify retinal vascular changes

Additional testing (as clinically indicated)
- Rule out chronic renal disease
  - Advanced imaging: renal scan; magnetic resonance angiogram; duplex Doppler flow studies; 3-dimensional computed tomography; arteriography (classic or digital subtraction) Rule out renovascular disease
  - Ambulatory blood pressure monitoring Rule out physician anxiety-induced (“white-coat”) hypertension
  - Hormone levels (thyroid, adrenal) Rule out hyperthyroidism, adrenal dysfunction
  - Plasma renin levels Rule out mineralocorticoid-related disease

Urine and plasma catecholamines Rule out catecholamine-mediated hypertension

Management
- Therapeutic Lifestyle Changes
- Weight reduction is the primary therapy for obesity-related hypertension.
• Prevention of excess or abnormal weight gain will limit future increases in BP.
• Regular physical activity and restriction of sedentary activity will improve efforts
• weight management and may prevent an excess increase in BP over time.
• Dietary modification should be strongly encouraged in children and adolescents who have BP levels in the prehypertensive range as well as in those with hypertension.
• Family-based intervention improves success.

Pharmacologic Therapy of Childhood Hypertension

The goal for antihypertensive treatment in children should be reduction of BP to <95th percentile, unless concurrent conditions are present. In that case, BP. should be lowered to <90th percentile.

Indications for Antihypertensive Drug Therapy in Children
- Symptomatic hypertension
- Secondary hypertension
- Primary hypertension when blood pressure is unresponsive to lifestyle changes.
- Hypertensive target-organ damage (LVH; retinopathy, proteinuria)
- Diabetes (types 1 and 2)

Severe, symptomatic HPT. should be treated with intravenous antihypertensive drugs. Pharmacologic therapy, when indicated, should be initiated with a single drug.

Acceptable drug classes for use in children include:-
ACE inhibitors,
Angiotensin receptor blockers
Beta-blockers,
Calcium channel blockers,
Diuretics.
Vasodilators

ACEI (captopril) Block the conversion of angiotensin I to II
• Dose: 0.5-2 mg/kg/day every 8 hours
• Side effects can cause: Hyperkalemia, neutropenia, dry cough, rash

Ca channel blockers (Nifedipine) Interfere with calicum influx into the cells lead to vasodilatation
* Dose: 0.25-0.5 mg/kg/dose every 4-6 hours
* Side effects: Headache, dizziness, tachycardia, hypotension

β-adrenergic antagonists (Propranolol) Reduce the heart rate and cardiac output maximally during exercise
• Dose: 0.5-2 mg/kg/day every 6-12 hours
• Side effects: GIT disturbance, bradycardia, bronchospasm, sleep disturbance, depression

Direct vasodilators (ex. Hydralazine )
*Dose of hydralasine: 0.5-2 mg/kg/dose 2-4/d
*Side Effects: SLE like picture, lymphadenopathy, fever, arthritis, headache, dizziness, confusion

Diuretics (ex. Furosemide, Thiazide, spironolactone)
Increase water and salt excretion →
ex. Furosemide (dose: 0.5-2 mg/kg/dose 2x side effects hypokalemia, hyperglycemia)
- Thiazide (dose: 5-10 mg/kg/dose, side effects hypokalemia, rash, hyperglycemia)
- spironolactone (dose 1-3 mg/kg/dose, side effects hyperkalemia, gynaecomastia, impotence, rash)