Evaluation and management of hypertension in children

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Objectives

- Why Hypertension is important in Pediatrics.
- Definition, classifications, causes and the association between Childhood Obesity and Hypertension.
- How to Evaluate and Manage Hypertension in Your Practice
Complications of Hypertension: End-Organ Damage

Hypertension

- Hemorrhage, Stroke
- Retinopathy
- Peripheral Vascular Disease
- Renal Failure, Proteinuria
- LVH, CHD, CHF

CHD = coronary heart disease
CHF = congestive heart failure
LVH = left ventricular hypertrophy

Hypertension Definitions

- Normal BP: Both systolic and diastolic BP < 90th % for age, gender, and height

<table>
<thead>
<tr>
<th>Age, y</th>
<th>BP Percentile</th>
<th>SBP, mm Hg</th>
<th>DBP, mm Hg</th>
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TABLE 3. BP Levels for Boys by Age and Height Percentile
Pediatric Classifications

- The Fourth Report 2004 includes new classifications for hypertension
- Prehypertension
- Stage 1
- Stage 2
What does this percentile mean?²

<table>
<thead>
<tr>
<th>Condition</th>
<th>Percentile</th>
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<tr>
<td>Normal</td>
<td>&lt;90&lt;sup&gt;th&lt;/sup&gt;</td>
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<tr>
<td>Prehypertension</td>
<td>90-&lt;95&lt;sup&gt;th&lt;/sup&gt; or if &gt;120-80</td>
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<tr>
<td>Stage 1 hypertension</td>
<td>95&lt;sup&gt;th&lt;/sup&gt;-99&lt;sup&gt;th&lt;/sup&gt; plus 5 mm Hg</td>
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<tr>
<td>Stage 2 hypertension</td>
<td>&gt;99&lt;sup&gt;th&lt;/sup&gt; plus 5 mm Hg</td>
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- **Hypertension**—average SBP and/or DBP that is greater than or equal to the 95th percentile for sex, age, and height on 3 or more occasions.

- **Prehypertension**—average SBP or DBP levels that are greater than or equal to the 90th percentile, but less than the 95th percentile.
  - Adolescents with BP levels greater than or equal to 120/80 mmHg should be considered prehypertensive.
Measurement of Blood Pressure

- Children >3 years old should have their BP measured when seen in a medical setting
- Preferred method: Auscultation
  - Requires a cuff that is appropriate for the child’s arm
  - Right arm preferred
When should Children < 3 years old have a BP check?

1. Prematurity, LBW, or NBICU grad.
2. Chronic illness; especially renal, cardiac, neurologic or endocrine.
3. Treatment with drugs known to raise BP.
4. Systemic conditions associated with hypertension (Neurofibromatosis, Tuberous Sclerosis, Hyperthyroid, etc).
Measuring BP in Children

- Choose appropriate cuff for **body size** (not just age).
- Child should be **quiet and calm** for 3-5 minutes prior to measurement.
- Cuff or stethoscope bell should be at **heart level**.
- Record BP 2-3 times and take the average for the best estimate.
Measurement of BP in Pediatrics

- Main source of error – Using wrong cuff size
- Small cuff - overestimates BP
- Large cuff - underestimates BP
Measuring the BP:
Determining proper cuff size by patient arm size

The cuff bladder width should be 40% of the circumference of the arm measured at mid arm.
Measuring the BP: Determining proper cuff size

- The cuff bladder length should cover 80% to 100% of the circumference of the arm.
Auscultative BP Measurement

- Blood pressure should be measured with cubital fossa at heart level.

- The arm should be supported.

- The stethoscope bell is placed over the brachial artery pulse, proximal and medial to the cubital fossa, below the bottom edge of the cuff.

- If the leg is used in children, the same size and position criteria apply.
Confirming High BPs

- To confirm HTN, BP should be measured in both arms and in one leg.

  - Normally, BP is 10 to 20 mm Hg higher in the legs than the arms.

  - If the leg BP is lower than the arm BP or if femoral pulses are weak or absent, coarctation of the aorta may be present.
New 2004 BP tables

- Includes 50%, 90%, in addition to 95% and 99% BP data.

- BP grouped by age, gender and height %

- Height data based on new CDC growth charts [www.cdc.gov/growthcharts](http://www.cdc.gov/growthcharts)
## Using BP Tables

**Example 1:**

**Age = 5 years**

- **BP 107/65 mmHg**
- **Gender = Male**
- **Height = 105 cm** *(25%)*

![Graph showing 2 to 20 years: Boys Stature-for-age and Weight-for-age percentiles](http://www.cdc.gov/growthcharts)
Using the New BP Tables

5 y.o. Boy
BP 107/65
Height: 25%

BP% mmHg
95% 110/71
99% 118/79
99%+5 123/84

Dx: No HTN

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Dx: No HTN
Infants: Use Systolic BP

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<tr>
<th>Age Group</th>
<th>90% SBP</th>
<th>95% SBP</th>
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<tr>
<td>&lt; 7 days</td>
<td>90 mmHg</td>
<td>95 mmHg</td>
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<td>8-30 days</td>
<td>100 mmHg</td>
<td>105 mmHg</td>
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<td>1-12 months</td>
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HTN Definitions

- Primary (Essential)
  - No underlying etiology identified.

- Secondary
  - An underlying disorder identified.
Essential, 2%  Secondary, 98%  

Essential, 75%  Secondary, 25%
Conditions associated with hypertension in children
1. Multicystic dysplastic kidney
2. Chronic pyelonephritis
3. Reflux nephropathy
VASCULAR

- Coarctation of thoracic or abdominal aorta
- Renal artery lesions (stenosis, fibro muscular dysplasia, thrombosis, aneurysm)
- Umbilical artery catheterization with thrombus formation
- Neurofibromatosis (intrinsic or extrinsic narrowing for vascular lumen)
- Renal vein thrombosis
- Vasculitis
1. Hyperthyroidism
2. Hyperparathyroidism
3. Congenital adrenal hyperplasia (11β-hydroxylase and 17-hydroxylase defect)
4. Cushing syndrome
5. Primary aldosteronism
CENTRAL NERVOUS SYSTEM

1. Intracranial mass
2. Hemorrhage
Pediatric Symptoms

- Hypertension is often thought of as a silent disease because typically there have not been any classic symptoms

- 3 most common symptoms
  - headache
  - difficulty initiating sleep
  - daytime tiredness
unless the pressure has been rising rapidly, HPT does not produce symptoms

- Headache
- Dizziness
- Epistaxis
- Anorexia
- Visual changes

Seizures may occur in hypertensive encephalopathy which is suggested by the presence of vomiting, temperature elevation, ataxia, stupor, and seizures.
Children with *secondary hypertension* usually not produce symptoms. Therefore, clinical manifestations of the underlying disease are the most frequent reasons for detecting HPT.
Clinical Evaluation of Stage 1 and 2 HTN

Complete H & P

1. In all kids rule out common secondary causes of HTN:
   - **Renal**: Ultrasound, BUN, Creatinine, UA, Renin
   - **Cardiac**: Femoral pulses, CBC, Echocardiogram
   - **Endocrine**: Electrolytes
   - Fasting lipids, triglycerides and glucose

2. In selected patients look for rare causes of HTN
   - symptoms to suggest a rare cause:
     - Malignancy, neurologic, drugs, Reno-vascular disease, Thyroid disease, etc.
Clinical Evaluation of HTN

4. Consider Essential HTN if
   - Child is ≥ 14 years with mild-moderate BP elevation
   - Family history of HTN
   - Elevated BMI

- **24 hour Ambulatory BP monitoring** (ABPM) is good first step in these patients.

- If elevated BMI coexists, assess co-morbid risks
  - Fasting Glucose, lipids and insulin

Obesity and HTN in Children

- HTN in children has increased 3-fold since the 1980s.
- Obesity prevalence has tripled in the last 30 years.
- Obesity brings with it glucose intolerance, dyslipidemia, hepatic disease, orthopedic problems, psychological disorders and future cardiovascular disease.
Which kids with high BP should you treat?

- Treat everyone with Therapeutic Lifestyle Changes (TLC)
Therapeutic Lifestyle Changes

- If obese, make a goal to gradually get $\text{BMI} < 85\%$
  - Set realistic, achievable, pace of weight loss.

- **Exercise:**
  - Moderate to vigorous aerobic activity for 40 min, 3-5 days/week

- **Diet:**
  - Avoid sugary foods/drinks and saturated fats. Less salt.
  - Eat fruit, vegetables, lean meats and whole grains.
  - 50/50 plate

- Involve the whole family as partners.
Indications for Antihypertensive Drug Therapy

- Symptomatic hypertension
- Secondary hypertension
- Hypertensive target-organ damage
- Diabetes (types 1 and 2)
- Persistent hypertension despite nonpharmacologic measures
Pharmacologic Therapy for Childhood Hypertension

- Pharmacologic therapy should be initiated with a single drug.

- The goal for antihypertensive treatment in children should be reduction of BP to <95th percentile.

- Severe, symptomatic hypertension should be treated with intravenous antihypertensive drugs.
Step-wise Approach to Therapy

1. Start with a small dose of a single anti-hypertensive drug
2. Increase dose of single anti-hypertensive drug (to max dose if tolerated)
3. Add a small dose of a second drug
4. Increase dose of second anti-hypertensive medication
Antihypertensive Medication

- Angiotensin Converting Enzyme-Inhibitors
- Angiotensin Receptor Blockers
- Calcium Channel Blockers
- Diuretics
- Beta-Blockers
- Central alpha-agonists
- Peripheral alpha-antagonist
- Vasodilators
## Drug Options for Initial Therapy

<table>
<thead>
<tr>
<th>Class of Drugs</th>
<th>Patients’ Characteristics</th>
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<tbody>
<tr>
<td>ACE-Is/ARBs</td>
<td>First-line therapy</td>
</tr>
<tr>
<td>CCBs</td>
<td>First-line therapy</td>
</tr>
<tr>
<td>Diuretics</td>
<td>Adjunct second-line drug</td>
</tr>
<tr>
<td>β-Blocker</td>
<td>Avoid in athletes (controversial) and people with diabetes</td>
</tr>
</tbody>
</table>
Angiotensin converting enzyme inhibitor (ACEI)

(ex. Captopril, enalapril, lisinopril)

Block the conversion of angiotensin I to II
(potent vasoconstrictor)

0.5-2 mg/kg/day every 8 hours

Side effect:
Hyperkalemia, neutropenia, dry cough, rash
ARB1-3, 5

- Angiotensin Receptor Blockers
- Irbesartan*, Losartan*

Mechanism of Action: angiotensin II receptor antagonist; blocks the vasoconstrictor and aldosterone-secreting effects of angiotensin II
Losartan
Angiotensin-receptor blocker

**Initial**: 0.7-1.4 mg/kg/day up to 100 mg/day *oral*

Should be given every 4 hours when given iv bolus. Recommended dose is lower than FDA label
Ca channel blockers

(ex:Nifedipine, amlodipine)

Interfere with calcium ion influx into the vascular smooth muscle cells lead to vasodilatation

(dose of nifedipine 0.25-0.5 mg/kg/dose every 4-6 hours)

Side effect: edema, headache, dizziness, tachycardia, hypotension
Diuretics

- ex. Furosemide, Thiazide, Spironolactone
  - Increase water and salt excretion

- Furosemide .......... 0.5-2 mg/kg/dose 2x
- Thiazide .......... 5-10 mg/kg/dose
- Spironolactone ...... 1-3 mg/kg/dose

Side effect

- Furosemide → hypokalemia, hyperglycemia
- Thiazide → hypokalemia, rash, hyperglycemia
- Spironolactone ---- hyperkalemia, gynaecomastia, rash
**β-adrenergic antagonists** (ex. Propranolol, atenolol, metoprolol)

- Block B receptors, 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
Labetalol α- and β-blocker

- Initial: 1–3 mg/kg/day

Maximum: 10–12 mg/kg/day up to 1,200 mg/day

1. Asthma and overt heart failure are contraindications

2. Should not be used in insulin-dependent diabetics
Direct vasodilators

- Hydralazine dose: 0.2–0.6 mg/kg/dose. Should be given every 4 hours when given iv bolus. Side effects: SLE-like picture, lymphadenopathy, fever, arthritis, headache, dizziness, confusion.

- Sodium nitprusside: IV infusion 0.53–10 mcg/kg/min. Monitor cyanide levels with prolonged (>72 hr) use or in renal failure; or coadminister with sodium thiosulfate.
Conclusions

- Use patient’s BP Percentile to determine if they have hypertension.
- First-line agents to treat hypertension are ACE-I/ARB or CCB.
- Diuretics are usually used as second line therapy.
References


Thank you