Initial Management Strategy for a Child or Adolescent with Elevated Blood Pressure in the Office

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Pediatric Nephrology
Disclosures

• Disclosure of Relevant Financial Relationships: None

• Off-Label Use:
  Extended release nifedipine, Isradipine
  Labetalol, Atenolol, Propranolol, Clonidine, Hydralazine,
  Minoxidil, Hydrochlorothiazide, Furosemide
Objectives

• Identify, evaluate and treat hypertension in the primary care office

• Describe diet and lifestyle modifications for patients diagnosed with hypertension

• Identify common ways that specialists treat hypertensive children

• Implement an appropriate referral to a specialist
Epidemiology

- Prevalence in the 1980’s was 2%

- Comparison of NHANES II to NHANES III data demonstrates a trend in increasing BP among children
  - Systolic 1.4 mmHg and diastolic 3.3 mmHg
  - Appears to parallel rise in increasing BMI

- Prevalence Hypertension 3%
- Prevalence Prehypertension 10%

- Prevalence of HTN 4.5% in school age children, up to 13.8% in obese children

- Follow-up studies reveal an overall incidence of HTN 0.5%/year
Blood Pressure Monitoring

• Auscultatory
  – Similar pitfalls as in adults
  – 74% of readings obtained at vital sign station were higher than those obtained in the exam room by 13 mmHg / 10 mmHg

• Oscillometric *
  – Omron / Life Source: 7-9” and 9-13” cuff (approx $65, plus $30)
  – Dinamap—readings high and consider using different nomogram (+10/5 mmHg)
  – A&D UA-778, Datascope Accutorr Plus and Omron 705CP

*No Financial Conflict/Interest
## Blood Pressure Monitoring

<table>
<thead>
<tr>
<th>Description</th>
<th>Price</th>
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<tbody>
<tr>
<td>Ultrasonic Doppler Flow Detector</td>
<td>$1000</td>
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<tr>
<td>Stetho Dop</td>
<td>$400</td>
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</table>

- Can under estimate the systolic blood pressure if child moves
- No diastolic values
Definition of Hypertension-Casual

- Prehypertension: Average SBP or DBP levels that are ≥ 90th percentile but ≤ 95th percentile
  - As with adults, patients with BP levels ≥ 120/80 mmHg should be considered pre-hypertensive
- Hypertension: Average SBP and/or diastolic BP that is ≥ 95th percentile for gender, age, and height on ≥3 occasions
  - Stage 1 HTN: 95th to 99th percentile + 5mmHg
  - Stage 2 HTN: >99th percentile + 5mmHg
Definition of Hypertension: Casual

Table 1
Blood pressure status in 12-year-old boy by age and height percentile

<table>
<thead>
<tr>
<th>SBP</th>
<th>Height percentile</th>
<th>5th</th>
<th>10th</th>
<th>25th</th>
<th>50th</th>
<th>75th</th>
<th>90th</th>
<th>95th</th>
</tr>
</thead>
<tbody>
<tr>
<td>BP %</td>
<td>50th</td>
<td>101</td>
<td>102</td>
<td>104</td>
<td>106</td>
<td>108</td>
<td>109</td>
<td>110</td>
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<tr>
<td>90th</td>
<td>115</td>
<td>116</td>
<td>118</td>
<td>120</td>
<td>121</td>
<td>123</td>
<td>123</td>
<td></td>
</tr>
<tr>
<td>95th</td>
<td>119</td>
<td>120</td>
<td>122</td>
<td>123</td>
<td>125</td>
<td>127</td>
<td>127</td>
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<tr>
<td>99th</td>
<td>126</td>
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<td>129</td>
<td>131</td>
<td>133</td>
<td>134</td>
<td>135</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>DBP</th>
<th>Height percentile</th>
<th>5th</th>
<th>10th</th>
<th>25th</th>
<th>50th</th>
<th>75th</th>
<th>90th</th>
<th>95th</th>
</tr>
</thead>
<tbody>
<tr>
<td>BP %</td>
<td>50th</td>
<td>59</td>
<td>60</td>
<td>61</td>
<td>62</td>
<td>63</td>
<td>63</td>
<td>64</td>
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<td>90th</td>
<td>74</td>
<td>75</td>
<td>75</td>
<td>76</td>
<td>77</td>
<td>78</td>
<td>79</td>
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<td>95th</td>
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<td>99th</td>
<td>87</td>
<td>88</td>
<td></td>
<td>89</td>
<td>90</td>
<td>90</td>
<td>91</td>
<td></td>
</tr>
</tbody>
</table>

Normal BP (<90th percentile): BP < 120/76.
Prehypertension (BP between 90th and 95th percentile or <120/80): SBP of 120–122 and DBP of 76–80.
Stage 1 hypertension (BP between the 95th and 99th percentile + 5 mm Hg): SBP of 123–136 and DBP of 81–94.
Stage 2 hypertension (BP above the 99th percentile + 5 mm Hg): BP > 136/94.

Ambulatory Blood Pressure Monitor (ABPM)

• Definition of hypertension for ABPM:
  – Average (mean) blood pressure >95% for sex and height
  – Blood Pressure Load (median) – When > 50% of the patients BP readings are greater than the 95% value for gender and height
  – Nocturnal dipping - ≥ 10% drop in BP during sleep
Definition of Hypertension-ABPM

Ambulatory Blood Pressure Monitoring in Children and Adolescents: Recommendations for Standard Assessment: A Scientific Statement From the American Heart Association Atherosclerosis, Hypertension, and Obesity in Youth Committee of the Council on Cardiovascular Disease in the Young and the Council for High Blood Pressure Research: *Hypertension* 2008;52;433-451
White Coat Hypertension

• White-coat HTN: persistently elevated BP ≥ 95th percentile in the office, but normal ambulatory readings.

• Prevalence 1 to 60%
  – Variability in how office blood pressure readings obtained
  – Different criteria for defining “normal” BP on ABPMs

• Currently treated as if categorized as “pre-hypertensive” patient
Hypertension: “Silent?”

Prevalence of Symptoms

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Normal BP</th>
<th>Hypertension-pretx</th>
<th>Hypertension-posttx</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdominal Pain</td>
<td>3.0%</td>
<td>10.4%</td>
<td>3.4%</td>
</tr>
<tr>
<td>Headaches</td>
<td>10.3%</td>
<td>42%</td>
<td>6.2%</td>
</tr>
<tr>
<td>Chest Pain</td>
<td>4.7%</td>
<td>14.2%</td>
<td>3.4%</td>
</tr>
<tr>
<td>Tired</td>
<td>5.5%</td>
<td>26%</td>
<td>10%</td>
</tr>
<tr>
<td>Difficulty sleeping</td>
<td>1.3%</td>
<td>7.7%</td>
<td>2.3%</td>
</tr>
<tr>
<td>Difficulty in school</td>
<td>4.5%</td>
<td>9.6%</td>
<td>8.8%</td>
</tr>
</tbody>
</table>

Approach to Elevated Blood Pressure

Pre-Hypertension Work-up

- None necessary unless co-morbid conditions exist
- Follow-up in 6 months
- Consider monitoring in the interim
Stage 1 Hypertension Work-up

- Option 1 - asymptomatic, comorbidity limited to obesity
  - Check fasting cholesterol, uric acid and glucose
  - Encourage lifestyle modification
  - Monitor over 3 months, if still high then Option 2

- Option 2 - symptomatic or comorbidities
  - Confirm elevated BP over next couple of weeks
  - Diagnostic work-up to include: renal ultrasound, urinalysis, urine microalbumin/creatinine, electrolytes, renal function, glucose, uric acid, cholesterol, echocardiogram, sleep apnea screen
  - Case by case decision: thyroid screen, serum metanephrines, renin/aldosterone, cortisol
Stage 2 Hypertension Work-up

- Confirm elevated BP over next couple of hours to days
- Diagnostic work-up to include: renal ultrasound, urinalysis, electrolytes, renal function, glucose, uric acid, cholesterol, echocardiogram, sleep apnea screen
- thyroid screen, serum metanephrines, renin/aldosterone, cortisol
- +/- CT angiogram of renal arteries
- Case by case testing: renal arteriogram, genetic testing for AME, Liddle syndrome, Turner syndrome, Tuberous sclerosis, Williams syndrome, etc
Should obesity exclude work-up for secondary hypertension?

• 80% of adolescents with secondary hypertension have BMI> 85%

• 90% of adolescents with stage II hypertension have BMI>85%

• 40% of adolescents with stage I hypertension have secondary hypertension
Lifestyle Changes

• Reduction of BMI by 10% can lead to 8-16 mmHg drop in SBP

• Positive correlation between the amount of caffeine consumed and daytime sys-ABPM and dia-ABPM results

• Small reduction in blood pressure with lower sodium intake
  – <1.2gm/day 4-8yrs
  – <1.5gm/day older children
  – <2.4gm/day older teenagers/adults

• Low “uric acid diet”—limit red meats, fructose, alcohol?

• Daily physical activity
Sports Participation

- Patients with Stage I hypertension and no symptoms may participate in sports with no limitations.
- Patients with Stage II hypertension should not participate in high-static sports until blood pressure within the normal range.

AAP Athletic Participation by Children and Adolescents who have Systemic hypertension. 2010
Obesity

- 38 adolescents evaluated pre and post bariatric surgery

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI (kg/m²)</td>
<td>60 +/-9</td>
<td>40 +/-8</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Kg over IBW</td>
<td>114 +/-27</td>
<td>54 +/-25</td>
<td></td>
</tr>
<tr>
<td>Systolic BP</td>
<td>121 +/-13</td>
<td>109 +/-10</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>ECHO: LVMI</td>
<td>54 +/-13</td>
<td>42 +/-10</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

Antihypertensive drug therapy: Indications

• Stage 2 hypertension
• Symptomatic hypertension
• Secondary hypertension
• Hypertensive target-organ damage
• Diabetes (type 1 and 2)
• Persistent stage 1 hypertension despite lifestyle modifications (3 months)
Antihypertensive drug therapy

- FDA Modernization Act (FDAMA) in 1997
  - Legislation that granted 6 additional months of patent protection if they conducted pediatric trials
  - Resulted in 10 antihypertensive medications with FDA-approved pediatric labeling
Antihypertensive Therapy: FDA

- Angiotensin Converting Enzyme Inhibitors
  - Benazepril
  - Enalapril
  - Fosinopril
  - Lisinopril

- Angiotensin II Receptor Blockers
  - Candesartan
  - Irbesartan
  - Losartan
  - Olmesartan

- Calcium Channel Blockers
  - Amlodipine

- Beta-blockers
  - Metoprolol

- Diuretics
  - Eplerenone - Ineffective
Antihypertensive Therapy: NON-FDA approved

- Extended release nifedipine
- Isradipine
- Labetalol
- Atenolol
- Propranolol
- Clonidine
- Hydralazine
- Minoxidil
- Hydrochlorothiazide
- Furosemide
Referral Pearls

• Consider referral:
  – If requiring escalating doses of medications
  – Associated renal disease
  – Family or provider would like additional reassurance that pharmacological treatment is indicated

• If being seen for a referral, then the below may occur:
  – Blood pressure medication placed on hold for 2 wks
  – 24 ABPM prior to visit
  – Evaluate for end organ damage, including ECHO
  – Extensive evaluation for secondary forms of hypertension
Conclusion

- The increasing prevalence of hypertension is coinciding with the obesity epidemic.
- The diagnosis of hypertension is based on the use of blood pressure charts, corrected for gender, age, height.
- First line therapy is life style modification, including exercise, low sodium diet, and weight loss.
- There is an increasing number of FDA approved antihypertensive medications for use in children.