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EDITOR :

DR. B. SANJEEV RAI

EDITORIAL OFFICE

Medicare Centre
Karangalpady, Mangalore - 575 003
Ph : (0824) 2238399 (O),
Fax : (0824) 2430361
E-mail : raibs11@gmail.com
Mob. : 94481-33494

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APPROACH TO MANAGEMENT OF SECONDARY HYPERTENSION IN CHILDREN

*Vikram Singhal, Sucheta Rao, Nutan Kamath

Hypertension is defined as average systolic and/or diastolic pressure >95th percentile for gender, age and height on >3 occasions. In developed countries, the estimated prevalence in children is 1%-2%. Surveys suggest a prevalence of 2%-5% in Indian school children. Hypertension in children can be essential (primary) or secondary (identifiable underlying cause). A secondary etiology may be suggested by

symptoms, examination findings or laboratory abnormalities. Up to 85 percent of children with hypertension have an identifiable cause, most often renal parenchymal disease. An age-based approach to the differential diagnosis is recommended.

The ABCDE mnemonic can be used to help determine a secondary cause of hypertension

TABLE I- Causes of Secondary Hypertension in Different Age Groups

Age	Causes [#]
Newborns	Renal artery thrombosis, renal artery stenosis, Congenital malformation, coarctation of aorta, Bronchopulmonary dysplasia
Infancy-6 yr	Renal parenchymal disease (Chronic glomerulonephritis, reflux nephropathy, obstructive uropathy, polycystic kidney disease), renal artery stenosis, Coarctation of aorta
6-10 yr	Renal artery stenosis, Renal parenchymal disease.
Adolescence	Renal parenchymal disease
#_Others causes	
	Endocrine: Pheochromocytoma, cushing syndrome, congenital adrenal hyperplasia, primary hyperaldosteronism, Liddle's syndrome, neuroblastoma
	Renal tumors: Wilms' tumor, nephroblastoma
	Drugs: ibuprofen, naprosyn, pseudoephedrine, carbamazepine, cyclosporine, tacrolimus, methyl prednisolone, prednisolone, fludrocortisone, erythropoietin

A: ACCURACY, ALDOSTERONISM

Accuracy

The first step in diagnosing an elevated blood pressure reading is to investigate its accuracy. An inappropriate blood pressure cuff for age or tight-fitting sleeves that are not removed can give falsely wrong readings. The cuff should

encircle at least 80-100% of the arm and the bladder length should be >40% of the arm circumference. Measurements should be taken after 3 to 5 minutes of resting. White-coat hypertension (blood pressure that is elevated in the physician's office but normal at other times) accounts for about 20 percent of patients with elevated readings.

* Department of Pediatrics, Kasturba Medical College, Mangalore, Manipal University.

Appropriate charts with blood pressure ranges based on gender, age, and height percentiles for children should be used.

Aldosteronism

Primary hyperaldosteronism is defined as overproduction of aldosterone independent of its usual regulator the renin-angiotensin system.

B: BAD KIDNEYS, BRUITS

Bad Kidneys

Renal parenchymal disease can be a cause or consequence of hypertension. The renal damage decreases the kidneys' ability to excrete salt and excess fluid (resulting in a low renin state, as opposed to the high renin state found in renovascular hypertension).

Bruits

Renovascular hypertension results from compromised arterial supply to the kidneys and about 50% of patients have an abdominal bruit identifiable on examination.

C: COARCTATION, CATECHOLAMINES, CUSHING'S SYNDROME

Coarctation of the Aorta

Coarctation of the aorta the second most common cause of hypertension in children, is more common in boys. In neonates coarctation may present acutely as congestive heart failure, but it is usually diagnosed in children with the onset of hypertension, difference between upper limb and lower limb pulses or a cardiac murmur.

Catecholamines

Excess catecholamine levels play a role in white-coat hypertension and pheochromocytoma. Acute stress induces catecholamine release and often contributes to hypertension.

Cushing's Syndrome

Cushing's syndrome can cause hypertension via the mineralocorticoid effects of excess glucocorticoids.

D: DRUGS, DIET

Drugs

Many prescription and nonprescription drugs can cause or exacerbate hypertension Eg. ibuprofen, naprosyn, pseudoephedrine, carbamazepine, cyclosporine, tacrolimus, methyl prednisolone, prednisolone, fludrocortisone, erythropoietin

Diet

Excess consumption of dietary sodium is linked to chronic hypertension. Obesity also can cause hypertension.

E: ENDOCRINE DISORDERS

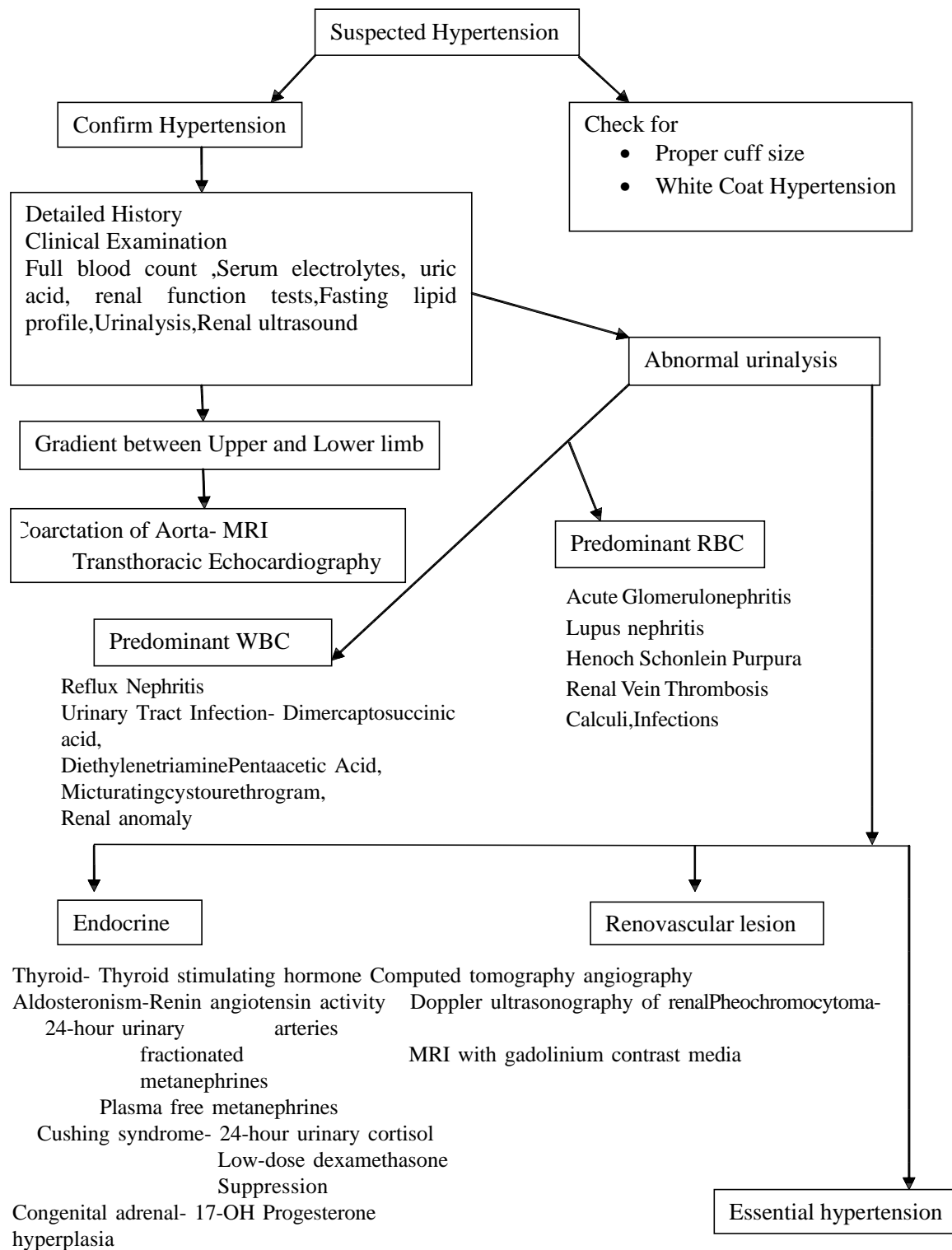
Endocrine Disorders

Hypothyroidism induces decreased cardiac output with a compensatory increase in vascular tone, resulting in rise in diastolic blood pressure whereas hyperthyroidism induces increased cardiac output and compensatory decreased vascular tone, causing a greater increase in systolic blood pressure.

Hyperparathyroidism (primary or secondary to chronic renal insufficiency) is a potentially reversible cause of hypertension. However, only 30 to 40 percent of patients with hyperparathyroidism have hypertension, and parathyroidectomy does not reliably resolve hypertension in patients with this disorder.

In pheochromocytoma, the symptoms can vary depending on the types of catecholamines being produced, the amount and frequency of their release into the circulation.

Figure 1: Algorithmic approach to evaluation of child with hypertension



Treatment

It is imperative to differentiate primary from secondary hypertension as treatment of the underlying cause of secondary hypertension can often normalize the blood pressure.

Principles of treatment

- The goal for treatment is reduction of blood pressure to levels <95th percentile, unless comorbid conditions or target-organ damage is present, when it should be lowered to <90th percentile of expected age, sex and height of the child
- Therapy is initiated with one agent, at an appropriate dose and the dose is increased until the desired blood pressure is achieved. If the highest dose is not effective or if there are side effects, a drug from a different class is added or substituted
- Medications with a longer duration of action (once, twice daily dosing) are preferred for better compliance and reduced side effects
- Dose adjustment of antihypertensive medications can be made every 2-3 days.

Lifestyle modifications

- Dietary changes- Recommendations for daily sodium intake range between 1-1.5 g.
- Physical exercise- 30-60 minutes or more of physical activity every day that is developmentally appropriate, enjoyable and involving a variety of activities

- Weight loss- Reduction of BMI by 10% is reported to lead to 8-12 mm Hg fall in blood pressure.

The choice antihypertensive drugs depend on the underlying cause.

Initial treatment with Calcium channel blockers (CCB) or beta adrenergic blockers (BB) or Angiotensin converting enzyme inhibitor (ACEi)

If BP continues to be >95th centile:

Use combination therapy - ACEi + CCB or ACEi + Thiazides or CCB + BB.

(Watch for bradycardia when combining BB and CCB)

*If BP continues to be >95th centile:
Add third agent - ACEi + CCB + Diuretic/BB.*

Other agents: prazosin, clonidine, hydralazine.

Choice of drugs according to the cause of hypertension

- Acute glomerulonephritis: Loop diuretic + CCB or ACEi
- Renovascular hypertension: CCB + diuretic

A BB instead of a CCB if ventricular function is normal or mildly deranged

- *Chronic kidney disease:* CCB, ACEi or BB

If two drugs are required, the ACEi (or BB) should be combined with a CCB.

Drug step-down: It might be possible in overweight children who have lost sufficient weight and also in patients in whom a specific intervention has treated the underlying cause for hypertension.

TABLE II- Choice of Antihypertensive Drugs

Drug	Dose initial	Maximum
Hypertensive emergencies		
Nifedipine	0.25 mg/kg	0.5 mg/kg
Sodium nitroprusside	0.5 µg/kg/min IV	8 µg/kg/min IV
Labetalol	1 mg/kg/hr IV, can be given 3 mg/kg/hr IV as bolus or steady infusion	
Long-term therapy		
Captopril Neonates	0.03 mg/kg/d	2 mg/kg/d
children	1.5 mg/kg/d	6 mg/kg/d
Enalapril	0.15 mg/kg/d	0.6 mg/kg/d
Losartan	0.7 mg/kg/d	1.4 mg/kg/d
Extended-release nifedipine	0.25 mg/kg/d	3 mg/kg/d
Amlodipine (maximum 20 mg/d)	0.1 mg/kg/dose	0.6 mg/kg/d
Propranolol	1 mg/kg/d	8 mg/kg/d
Atenolol	1 mg/kg/d	8 mg/kg/d
Prazosin	0.05-0.1 mg/kg/d	0.5 mg/kg/d
Minoxidil	0.1-0.2 mg/kg/d	1 mg/kg/d
Hydrochlorothiazide	1 mg/kg/d	2-3 mg/kg/d
Furosemide	1 mg/kg/d	12 mg/kg/d

Further Reading:

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