Chilhood Hypertension: An Update

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Studies in the field of childhood hypertension have been increasing in recent years, resulting in important new findings in the epidemiology, diagnosis and treatment of hypertension in children.

New data from the National Health and Nutrition Examination Survey have been added and the revised childhood BP tables now include the 50th, 90th, 95th, and 99th percentiles for sex, age, and height. Hypertension in childhood is defined as an average systolic or diastolic BP greater than 95th percentile for age, sex and height on at least three separate occasions. Accurate BP measurement is the basis for diagnosis and the proper technique of BP measurement in childhood has been published. The mercury sphygmomanometer is the gold standard for BP measurement but oscillometric devices provide a reasonable approximation, are easy to use and minimize observer error, especially in newborns and young children. Ambulatory BP monitoring may also be useful for assessment as well as therapeutic monitoring in children.

Hypertension during childhood is not rare. Often under diagnosed, an estimated prevalence is 1%-2% compared to 25%-35% of the adult.[1] Hypertension may be a sign of an underlying disease (secondary hypertension) or an early onset of essential hypertension. Most adult hypertension is essential hypertension but secondary hypertension is more prevalent in children. The underlying causes being renal parenchymal, renovascular, cardiovascular and endocrine diseases. Common causes of hypertension in children of varying ages are shown in Table 1.[2] Renal parenchymal diseases are the most common causes of hypertension during childhood whereas essential hypertension is the most common cause in adolescent and adult. After confirmation of hypertension, a thorough history and physical examination are essential. Investigations are usually needed to search for an underlying cause of hypertension, physicians should look for target organ damage and estimate the cardiovascular risk for the patient. Appropriate investigation tailored to the age, severity, history and physical examination has been proposed as in Fig 1.[2] The younger and more severe hypertensive patients usually require more investigations to determine the cause of hypertension. Severe hypertension should be controlled before submitting the child to a series of investigation to avoid acute complications.

Renal parenchymal diseases such as reflux nephropathy, congenital renal anomalies and chronic glomerulonephritis are the most common causes of hypertension in children. Renovascular hypertension is the second most common cause. Cardiovascular diseases such as coarctation of aorta are also found. Other rarer causes include endocrine diseases such as hyperthyroidism, Cushing's syndrome and pheochromocytoma. No identifiable cause is found in a large proportion of older children. The hypertension is therefore considered essential hypertension. Risks for essential hypertension include genetic predisposition, obesity, dietary sodium, potassium and calcium. Obesity has become an increasingly important medical problem in children and adolescents. Obese children are reported to have approximately a 3-fold higher risk of hypertension than non-obese children. Once considered rare, primary hypertension in children has become increasingly common in association with obesity and other risk factors, including family history of hypertension. Several rarer forms of inherited hypertension have also been described. Studies on the molecular basis of 4 forms of severe hypertension transmitted on an autosomal basis: glucocorticoid remediable aldosteronism, the syndrome of apparent mineralocorticoid excess, activation of the mineralocorticoid receptor, and Liddle syndrome has been done.

A study in 66 Thai children with persistent hypertension at Siriraj Hospital revealed: renal parenchymal diseases in 62.7%, renovascular diseases 7.5%, drug-induced 7.5%, essential hypertension 7.5%, tumor-related (Wilm's and

TABLE 1. Most common causes of hypertension in varying ages (adapted from reference 2)

	Common causes
Newborn	Renal artery thrombosis or embolus
	Renal vein thrombosis
	Congenital renal malformations
	Coarctation of aorta
	Renal artery stenosis
	Bronchopulmonary dysplasia
Infancy	Renal parenchymal diseases
	Renal artery stenosis
	Coarctation of aorta
	Drugs (e.g. corticosteroids, pseudoephedrine)
	Endocrine causes
6-10 years	Renal parenchymal diseases
	Renal artery stenosis
	Essential hypertension
	Endocrine causes
Adolescence	Essential hypertension
	Renal parenchymal diseases
	Drugs and substance abuse (e.g. oral contraceptives, cocaine, amphetamines, methamphetamines, methylphenidate, caffeine)
	Endocrine causes

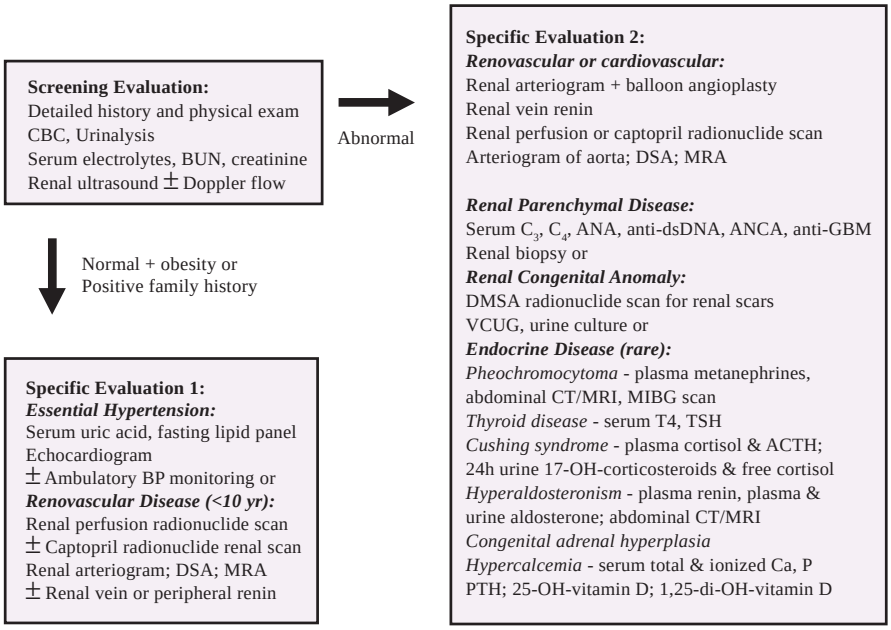

Fig 1. Suggested investigations for childhood hypertension (adapted from 2) ACTH, adrenocorticotropic hormone; ANA, antinuclear antibody; ANCA, antineutrophil cytoplasmic antibody; anti-dsDNA, anti-double-stranded DNA antibody; anti-GBM, anti-glomerular basement membrane antibody; BUN, blood urea nitrogen; C_3 and C_4, complements 3 and 4; CBC, complete blood count; CT, computed tomography; DMSA, dimercaptosuccinic acid; DSA, digital subtraction angiography; MIBG, metaiodobenzylguanidine; MRA, magnetic resonance angiography; MRI, magnetic resonance imaging; OH, hydroxyl; PTH, parathyroid hormone; T_4, thyroxine; TSH, thyroid-stimulating hormone; VCUG, voiding cystourethrogram

neuroblastoma) 4.5%, coarctation of aorta 3.0%, bronchopulmonary dysplasia 3.0%, pheochromocytoma 1.5% and unknown 1.5%. (unpublished data)

The most common complications of severe hypertension are hypertensive encephalopathy, cerebral infarction and hemorrhage, facial palsy, visual symptoms, cardiac failure and renal failure. Early but gradual reduction of BP is associated with a lower risk of neurological damage. After many years, untreated elevated BP also causes target organ damages including the blood vessels, brain, eyes, kidneys and heart.

Nonpharmacological treatments of hypertension can delay or prevent the need for antihypertensive agents. These include: dietary salt restriction, mineral supplementation (potassium, calcium, and magnesium), weight control, regular exercise, and lifestyle modification (alcohol, cigarettes, and stress reduction).[3] Antihypertensive drugs are usually needed in patients with secondary hypertension or target organ involvement. Angiotensin-converting enzyme inhibitors and calcium channel antagonists are commonly prescribed antihypertensive medications in children. Beta-adrenoreceptor antagonists, alpha-adrenoreceptor antagonists, alpha-adrenoreceptor agonists and direct vasodilators are less commonly used because of adverse effects. Diuretics are usually taken as adjunct therapy.

Antihypertensive drugs for hypertensive emergencies in children include hydralazine (IV, IM), labetalol (IV bolus or infusion), nicardipine (IV infusion), and sodium nitroprusside (IV infusion). Clonidine, enalaprilat, fenoldopam, isradipine and minoxidil may also be useful. Specific uses in neonatal, essential hypertension and various underlying diseases are described elsewhere.[3,4] Some underlying cause of hypertension, e.g., pheochromocytoma can be surgically curable and antihypertensive drugs may be discontinued soon afterward.

All children with hypertension need regular and long-term follow up with special attention paid to target organ injury and underlying diseases. Echocardiography is recommended for evaluating target organ abnormalities. Left ventricular hypertrophy can be an indication for initiating or intensifying drug therapy to lower BP. Monitor for the side effects if the child is on antihypertensive agents, an explanation of the disease and the need for treatment as well as education of patients and their parents about healthy lifestyle measures are essential.

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