GUIDELINES (JSH 2009)

Chapter 10. Hypertension in children

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POINT 10

1. Hypertension in children and adolescents is usually essential hypertension and is often complicated by obesity.
2. A marked increase in blood pressure is suggestive of secondary hypertension. Renal hypertension, particularly that due to congenital renal anomalies, is common in children.
3. Essential hypertension in children and adolescents is frequently complicated by left ventricular hypertrophy and can progress into adult essential hypertension.
4. For the treatment of essential hypertension, non-pharmacologic interventions should be attempted for 3–6 months. If these prove ineffective, pharmacologic therapy should be considered.
5. Indications for pharmacologic therapy in children include insufficient response to lifestyle modifications and complication by left ventricular hypertrophy. Ca channel blockers, angiotensin-converting enzyme (ACE) inhibitors and angiotensin II receptor blockers (ARBs) are recommended.

1) CHARACTERISTICS OF HYPERTENSION IN CHILDREN AND ADOLESCENTS

On blood pressure screening, essential hypertension is detected in 0.1–1% of fourth to ninth graders and approximately 3% of high school students.

Secondary hypertension is also detected, but it is infrequent. Generally, essential hypertension is mild with no clinical symptoms, but its complication by left ventricular hypertrophy and progression into adult hypertension are problems.

Essential hypertension is often found in obese children. The number of obese children has increased gradually since 1977, although the rate of increase has slowed during the last 10 years.

2) CRITERIA FOR HYPERTENSION

a. Blood pressure measurement

Accurate blood pressure measurement is indispensable for the diagnosis of hypertension. Blood pressure should be taken in a seated or supine position and, in small children, on the laps of a parent. The selection of an appropriate size cuff is also important. With mercury sphygmomanometers, cuffs of 7-cm wide for 3- to 6-year-olds, 9-cm wide for 6- to 9-year-olds and 12-cm wide (adult size) for those aged 9 years and above are recommended. However, the cuff should be selected according to the size of the child's upper arm rather than their age, and one with an inflatable bladder width exceeding 40% of the arm circumference at a point midway between the olecranon and the acromion and a length sufficient to cover 80% of more of the arm circumferences should be used.

b. Screening criteria

In the United States, detailed criteria for hypertension in children are determined according to sex, age and height.⁵⁹⁸ In Japan, however, reports concerning blood pressure in children are few, and the criteria shown in Table 10-1 were established (in the 2000 and 2004 editions of these Guidelines) on the basis of limited data.⁶⁵ The criteria relating to systolic blood pressure were approximately 10 mm Hg higher than those in the US, but when the blood pressure levels of approximately 40 000 elementary school and junior high school students in Japan measured by the Association of Preventive Medicine were evaluated according to these criteria, the prevalence of hypertension was 1.4% in male fourth graders, 1.8% in female fourth graders, 0.7% in male seventh graders and 1.3% in female seventh graders, which was generally in agreement with an earlier report. Therefore, the criteria calculated from data of general blood pressure examinations are considered to be appropriate for hypertension screening.

c. Criteria for blood pressure control

Criteria must be established from reliable blood pressure data and show values for different age levels. Table 10-2 shows the criteria for hypertension (95 percentiles) derived from the data of blood pressure measurement fulfilling these requirements.⁵⁹⁹ Blood pressure should be measured after sufficient rest in a quiet environment using an appropriate cuff. The value of the third of three consecutive measurements using automatic devices should be adopted. The systolic blood pressure of these criteria is close to the US criteria for hypertension for individuals at the 50th percentile in height.⁵⁹⁸ As the diastolic pressure is lower than the US criteria using a mercury sphygmomanometer, the method of measurement should be indicated as a note. In children with underlying diseases such as diabetes and kidney disease, in whom

Table 10-1 Criteria for hypertension screening

	Systolic blood pressure (mm Hg)	Diastolic blood pressure (mm Hg)
Pre-school children	≥120	≥70
<i>Elementary school</i>		
First to third graders	≥130	≥80
Fourth to sixth graders	≥135	≥80
<i>Junior high school</i>		
Boys	≥140	≥85
Girls	≥135	≥80
High school	≥140	≥85

Same as the JSH2004 criteria for hypertension.⁶⁵

Table 10-2 Criteria of hypertension for blood pressure management

Grade	Boys		Girls	
	Systolic	Diastolic	Systolic	Diastolic
<i>Elementary school</i>				
First	107	60	108	60
Second	112	63	108	60
Third	114	62	111	61
Fourth	116	63	121	66
Fifth	117	63	119	66
Sixth	119	63	119	65
<i>Junior high school</i>				
Seventh	125	66	126	68
Eighth	130	66	126	68
Ninth	136	68	128	70

As the criteria are set according to the mean height, they increase or decrease with the height.⁵⁹⁹

strict blood pressure management is necessary, the criteria shown in Table 10-2 are recommended.

In high school students, when the mean of the values on the second and third of three consecutive measurements using an automatic devices was used, and the 94th percentile value of systolic blood pressure and the 91st percentile and 95th percentile values of diastolic pressure in males and females, respectively, were set as criteria, they were 135/75 mmHg for males and 120/75 mmHg for females. Although these values are considerably lower than those reported earlier, it should be noted that the individuals were volunteers interested in lifestyle-related diseases and that those with a BMI of 30 or higher were excluded.

3) PATHOLOGICAL FEATURES OF HYPERTENSION IN CHILDREN

Hypertension detected by blood pressure screening is mostly essential hypertension. The diagnosis of essential hypertension in children is made in consideration of age (adolescence), degree of hypertension (mild), obesity, familial history or lack of symptoms suggestive of secondary hypertension. Children up to the third grade may be excluded from the diagnosis of essential hypertension.

The possibility of secondary hypertension increases with younger age or higher blood pressure. Hypertension related to kidney disease accounts for 60–80% of secondary hypertension in children, and scarred kidney (reflux nephropathy) associated with vesicoureteral reflux and chronic renal failure due to congenital renal abnormalities requires particular attention.

4) OBESITY AND HYPERTENSION

Hypertension is observed more frequently in obese children from the fourth to ninth grade (3–5%) than in those with a standard body size (0.5%).⁶⁰⁰ The prevalence of hypertension increases with the degree of obesity. Isolated systolic hypertension, which is a characteristic of obese children, is observed in 1.6% of males and 3.1% of females with mild obesity but in 8.3% of males and 12.5% of females with marked obesity.⁶⁰⁰ As hypertension and obesity in children frequently develop into essential hypertension and obesity in adulthood, they should be corrected during childhood.

5) NUTRITION OF THE FETAL PERIOD AND HYPERTENSION

Recently, there have been many reports that nutrition during embryonic and fetal development is related to the occurrence of lifestyle-

related diseases. According to results in Japan, blood pressure at the age of 3 years was higher with decreasing birth weight and increasing body weight.⁶⁰¹ Moreover, in a 20-year follow-up of 4626 individuals from birth, blood pressure was higher as birth weight decreased, and the serum cholesterol level was higher with lower increases in height from 3 to 20 years.⁶⁰²

A study of markedly obese children reported that those with a lower birth weight are more vulnerable to metabolic syndrome including hypertension.⁶⁰³ According to the Vital Statistics of Japan by the Ministry of Health, Labour and Welfare, the mean birth weight decreased from 3.19 kg in 1980 to 3.01 kg in 2005, and the percentage of low-birth-weight infants (<2500 g) increased from 5.18% in 1980 to 9.53% in 2005. These changes may be partly explained by the inadequate dietary intake of pregnant women, and a well-balanced diet is recommended both before and during pregnancy. Therefore, it is important to acquire an appropriate dietary habit during childhood for the prevention of lifestyle-related diseases not only in the future but also in the next generation.

6) PROBLEMS WITH ESSENTIAL HYPERTENSION IN CHILDREN AND ADOLESCENTS

Problems with essential hypertension in children and adolescents include complications (target organ damage) and the progression into adult essential hypertension. As a complication, left ventricular hypertrophy is observed in 10–46% of patients.⁶⁰⁴

According to the results of comparisons of blood pressure at junior high school age and after 20 years in Japan, 20.9% of hypertensive junior high school students were still hypertensive after 20 years, whereas 5.5% of normotensive individuals became hypertensive.⁶⁰⁵ In a study in which college students were re-examined after 8–26 years, hypertension was observed in 44.6% of the hypertensive but only 9.2% of the normotensive group.⁶⁰⁶ In an overseas large-scale study that followed up 1505 children aged 5–14 years for 15 years or longer (Bogalusa Heart Study),⁶⁰⁷ twice the expected number of individuals (40% for systolic blood pressure and 37% for diastolic blood pressure) whose levels were in the highest quintile in childhood remained there 15 years later. The prevalence of hypertension at the age of 20–31 years was much higher in individuals whose childhood blood pressure was in the top quintile: 3.6 times higher (18 vs 5%) in systolic blood pressure and 2.6 times higher (15 vs 5.8%) in diastolic blood compared with individuals in every other quintile.

7) LIFESTYLE MODIFICATIONS IN CHILDHOOD (PRIMARY PREVENTION OF HYPERTENSION)

It is extremely important to establish an appropriate lifestyle (dietary and exercise habits) from early childhood for the longterm prevention of lifestyle-related diseases.

a. Diet

Treatment for obesity involves restricting energy intake, balancing nutritional intake, and correcting unfavorable eating habits. Concurrent dietary and exercise therapies are more effective for the treatment of hypertension associated with obesity.

Epidemiologically, an excessive salt intake is involved in an increase in blood pressure. Salt restriction practiced from the neonatal period suppresses increases in blood pressure in childhood.²³² In addition, atherosclerosis begins in childhood, and the serum lipid levels in Japanese teenagers are elevating progressively. Therefore, appropriate dietary habits must be established through guidance

(education) on restricting salt and following a low-fat diet from early childhood. Salt restriction and the encouragement of potassium intake recommended as well as in adults (see Chapter 4).

b. Exercise

For the correction of obesity, exercise for pleasure is recommended. The total amount of daily exercise is more important than the exercise intensity for the prevention of increases in blood pressure whether obesity is present or not.

8) MANAGEMENT OF HYPERTENSION

Figure 10-1 shows the procedure for managing hypertension in children. In children and adolescents who are found to be mildly hypertensive through health screening, blood pressure should be measured repeatedly on different occasions. Blood pressure that always exceeds the screening criteria strongly suggests secondary hypertension in the absence of moderate or severe obesity. If there are no abnormal findings on physical examination, close examination, primarily of the kidneys, should be performed. Congenital renal abnormalities must always be considered, particularly in infants.

Home blood pressure measurement is also useful for the exclusion of white coat hypertension in children. Twenty-four-hour ambulatory blood pressure monitoring is useful not only for the diagnosis of white coat hypertension but also for the detection of target organ damage.⁶⁰⁴ The target of blood pressure control should be the diagnostic criteria of clinical blood pressure or below, but a lower target should be set for children with underlying diseases such as diabetes mellitus and chronic kidney disease.

Indications of drug treatment include: (1) symptomatic hypertension, (2) secondary hypertension, (3) complication by target organ damage, (4) complication by diabetes, (5) complication by chronic kidney disease and (6) hypertension persisting even after non-pharmacologic interventions (diet and exercise) over 3–6 months.⁵⁹⁸

a. Non-pharmacologic interventions

Since essential hypertension in children and adolescents is often mild, drug treatment should be considered only after attempting non-pharmacologic interventions for 3–6 months. As there is a report of success in reducing blood pressure by restricting the salt intake of high school students, this regime should be started. Dynamic

Figure 10-1 Procedure for hypertension management in children.

exercise (isotonic exercise) should be encouraged unless there are complications, because it not only reduces obesity but also produces a direct antihypertensive effect (see Chapter 4).

b. Drug treatment

The first choice of antihypertensive drug is an ACE inhibitor or a Ca channel blocker. ACE inhibitors such as captopril, enalapril and lisinopril have been confirmed to be effective and safe in children. ARBs are also used in children. Among Ca channel blockers, nifedipine and amlodipine are used frequently.

c. Antihypertensive drugs for special situations

β -blockers or Ca channel blockers should be used if there is migraine, and ACE inhibitors or ARBs, from which a kidney protective effect is

expected, should be used if there is diabetes mellitus or chronic kidney disease. In patients showing left ventricular hypertrophy, ACE inhibitors and ARBs should be used to attenuate the actions of growth factors (TGF- β , angiotensin II and so on).⁵⁹⁸

Citation Information

We recommend that any citations to information in the Guidelines are presented in the following format:

The Japanese Society of Hypertension Guidelines for the Management of Hypertension (JSH 2009). *Hypertens Res* 2009; **32**: 3–107.

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