Hypertension in Children and Adolescents

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Preface

Hypertension in the young must be studied in the young. The following statements indicate why the study of hypertension in children is necessary and will provide information not obtainable in the adult.

1. Antecedents of essential hypertension in adults must be looked for in the young. Investigation of the young will make it possible to seek markers and risk factors for the development of hypertension.

2. There is evidence that essential hypertension is a hereditary disorder. The genetics of the disorder are best studied at the earliest stage of life, before some environmental forces that may affect blood pressure are superimposed.

3. Since essential hypertension is asymptomatic in its earliest stages, vascular changes may have already occurred at the time of detection. Prevention of complications may be possible if children with high blood pressure are studied.

4. Prenatal influences on blood pressure can best be investigated in the newborn and very young infant.

5. Some forms of hypertension are more frequently diagnosed in the child than in the adult, for example, high blood pressure occurring with acute glomerulonephritis and congenital adrenal hyperplasia. Therefore, pediatric groups may provide the necessary study populations.

6. Some forms of hypertension are reversible in the child but not in the adult. "Dexamethasone-suppressible hyperaldosteronism" is associated with high blood pressure in children and in adults. This disorder has recently been described in three children and in their mother. Although the children's blood pressure levels decreased promptly with dexamethasone treatment, the mother remained hypertensive. Thus, failure to diagnose the syndrome in childhood, when hypertension responds to treatment, penalizes the adults as well as the child. Further research is required to determine why the child responds to treatment while the adult does not.

7. The long-term pharmacologic benefits and risks of treating children with hypertension are not known. Studies must be conducted to determine the effect of antihypertensive drugs on growth and puberty.

This volume touches on all these aspects and brings the reader up to date on the current status of hypertension in the developmental age.

Understanding the pathophysiology of childhood hypertension offers the best hope of reversing the hypertensive process before severe vascular complications intervene. Thus, research into childhood hypertension constitutes a form of preventive medicine to which this book, by summarizing the present knowledge on the subject, brings a valuable contribution.

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Brief Communications

Hypertension in Children and Adolescents,
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Studies of Blood Pressure and Hypertension in General Pediatric Practice

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The studies to be described were begun about 18 years ago. They were performed on asymptomatic children attending a private pediatrician's office and two pediatric clinics, and on students in five high schools in the metropolitan area of St. Louis, Missouri. At the beginning, a satisfactory definition of juvenile hypertension presented a problem, because our experience had already indicated that the frequently mentioned arbitrary values of 130/85 to 140/85–90 mm Hg were not appropriate for children of every age (1,5,8,9,16,18–21,23,26). Furthermore, the published data derived from blood pressure measurements in population samples of normal children were obtained under varying conditions and showed a considerable degree of variation (2,4,6,7,22,24,25,27).

Normal standards for office practice were therefore established. The means, standard deviations, and 90th and 95th percentiles for systolic and diastolic blood pressure were calculated for 795 boys and 798 girls, 3 to 15 years of age (Figs. 1 and 2) (10). The subjects were children brought to the pediatrician's office for routine physical examinations. Measurements were taken in the right arm, in the supine position, at the end of the examination and before any painful procedures. Cuffs with widths of approximately two-thirds of arm length and the mercury manometer were used. The fifth Korotkoff phase was considered to be diastolic pressure. Only one reading was recorded unless it seemed unusually high, in which case the lowest of three readings was used.

According to the suggestion of Master et al. for adults (17) systolic and/or diastolic blood pressures persistently above the 90th percentile for age and sex are considered to be suspicious, and those above the 95th percentile are regarded as hypertensive. The 95th percentile as the upper limit of normal is now accepted by many in the United States. In our practice, patients whose blood pressures remain above the 90th percentile and occasionally above the 95th percentile for more than one year are classified as being hypertensive.

One hundred and thirty-one such patients were followed for 2 to 9 years (13). Hypertension was found in patients as young as 3 years and in 29 children under the age of 6. The greatest number of hypertensive readings was detected

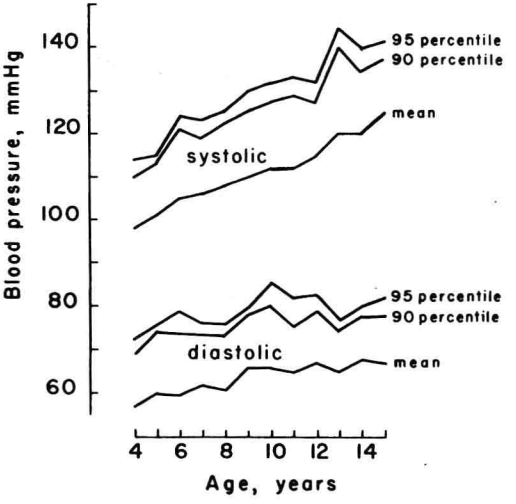

FIG. 1. Blood pressure for age in boys. (From ref. 9a, with permission.)

at age 5 and ages 8 to 12 years. Forty-one percent displayed systolic, 42% systolic and diastolic, and 17% diastolic hypertension. Thirty percent had normal blood pressure before they became hypertensive. One-half of 98 patients on whom three or more readings were taken showed an occasional normal reading, suggesting that they had labile hypertension. Sixty-five percent of 81 children

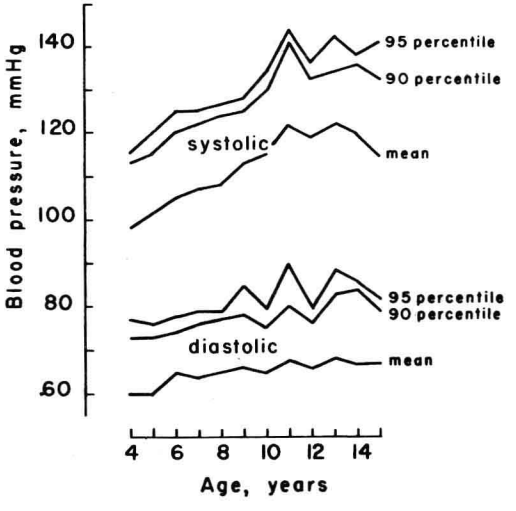

FIG. 2. Blood pressure for age in girls. (From ref. 9a, with permission.)

observed from 3 to 9 years still exhibited elevated pressure at their last examination. Hypertension was present in one or both parents of 51%, and 5% of the families had more than one hypertensive child. Obesity was present in 55%. The incidence of parental hypertension for normotensive children was 18%, and 15% were obese.

The first 74 hypertensive children, 4 to 18 years of age, were reported in 1971 (11). Initially, 33 subjects were investigated on an outpatient basis, using the following laboratory studies: serum sodium and potassium levels, urea clearance, 24-hour urinary catecholamine excretion, electrocardiogram, chest roentgenogram, and intravenous pyelogram when indicated. Because of the paucity of findings in this group, more extensive inpatient investigations were performed on the next 41 patients in the clinical research unit of St. Louis Children's Hospital. Laboratory determinations included serum sodium, potassium, chloride, creatinine, urea nitrogen, and plasma renin activity. The latter study was performed after the children had been ambulatory for 30 to 60 min. Twenty-four-hour urinary excretion of aldosterone, sodium, and creatinine was determined, as well as creatinine clearance. In addition, catecholamines were measured in two urine specimens obtained on successive days, and rapid-sequence intravenous pyelograms, chest roentgenograms, and electrocardiograms were performed.

With one exception, our last 57 patients were investigated on an outpatient basis. Creatinine clearance, serum potassium, creatinine, and urea nitrogen determinations, as well as rapid-scan intravenous pyelograms, chest roentgenograms, and electrocardiograms, were performed on 32 of these. Rapid-scan intravenous pyelogram was performed on only one of the remaining 25 patients.

A possible cause for hypertension was found in only 5% of patients studied. All of these had disease of the urinary tract, one patient with decreased maximum urea clearance and elevated nonprotein nitrogen, one with ureteral reflux, one with renal bleeding associated with sickle-cell trait, and three with pyelonephritis. Thus, 95% of children in whom high blood pressure was an incidental finding seemed to have primary hypertension. Because of our experience, we do not believe that extensive investigations are necessary in the absence of suspicious history, symptoms, or findings.

Although the observations described above indicate that the suggested definition of juvenile hypertension is a useful one, the ultimate answer will be found when we examine those of our patients who are now young adults. However, several points suggest that the concept is probably valid. The first is the significantly high incidence of parental hypertension and of obesity. Second, 60% of 48 patients considered to be hypertensive before the age of 10 had blood pressure readings >140 systolic and/or 90 mm Hg diastolic at one time or another.

The incidence of hypertension among black adults is nearly twice that of the general population in the United States, and the incidence of hypertensive heart disease almost triple that in white persons. For this reason, blood pressure studies were made in 2481 black and white children 3 to 14 years of age and