

# Paediatric hypertension: The importance of prevention and early diagnosis

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## Abstract:

High Blood Pressure and Hypertension (HTN) in pediatrics are increasing as a result of sedentary lifestyle associated with overweight and obesity that are becoming more prevalent in this population. Despite being a silent disease, it is associated early on with end-organ injuries that increase cardiovascular risk in adults and therefore lead to serious and sometimes fatal events. In addition to prevention, the correct diagnosis and early therapeutics are of great importance. This article aims to alert about the risks of high blood pressure in childhood and adolescence, preventive measures and early interventions, especially in those with primary HTN.

**Keywords:** Hypertension . Adolescents . Cardiovascular risk . Ambulatory blood pressure monitoring . Prevention

## Description

Hypertension in infants is uncommon and usually reflects the presence of an underlying disease. On the other hand, in children and adolescents, the prevalence of primary hypertension has increased as a result of the high prevalence of overweight and obesity, in the context of sedentary lifestyle, which may occur early in childhood [1,2]. It is currently estimated that the prevalence of high blood pressure [3] is 2.2%-3.5% and HTN of 3.5%, with higher values (reaching 30%) when associated with overweight or obesity [4,5].

Primary hypertension appears mostly in older and overweight or obese children, but also in those with a positive family history [6].

Secondary hypertension is more frequent in younger children and in those with higher blood pressure values. There are several causes for hypertensive disease in paediatric age, including renal disease (glomerulonephritis, renal polycystic disease, chronic kidney disease, congenital anomalies of the urinary system), cardiovascular disease (coarctation of the aorta, vasculitis, thrombosis of the renal vein) and endocrine disease (hyperthyroidism, hyperparathyroidism, congenital adrenal hyperplasia, Cushing's syndrome, primary hyperaldosteronism, pheochromocytoma). In older children, it is important to consider prescribed drugs (oral contraceptives, corticosteroids, sympathomimetics, immunosuppressants such as Tacrolimus and Cyclosporine), abuse drugs (e.g., cocaine) and the exaggerated consumption of caffeine, also associated with the development of HTN, usually intermittent [1,6].

The definition of HTN has been recently updated and blood pressure values should be interpreted according to Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) tables, considering gender, age and height, such as those provided by the European Society of Hypertension [1,7].

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Received date: November 06, 2020

Accepted date: November 20, 2020

Published date: November 27, 2020

Thus, for children aged between 1 and 13 years old, normal blood pressure values are below the P90 (SBP and DBP); SBP and DBP values between P90 and P95 are considered high blood pressure values; stage I hypertension is defined as SBP and/or DBP values between P95 and P99 and stage II hypertension for SBP and/or DBP > P99 values. For those 13 years old or older, values below 120/80 mmHg are considered normal; high blood pressure values are SBP between 120-129 mmHg and DBP < 80 mmHg; stage I hypertension if values are between 130/80 and 139/89 mmHg and stage II hypertension if values greater than 140/90 mmHg [1,4,8].

For healthy children, an annual blood pressure assessment is recommended from the age of 3 [1,4,6]. If the children are obese, have diabetes or if they are taking medication that can increase blood pressure, this assessment should be made in all medical appointments [4]. In particular situations, this assessment should be made earlier: children born prematurely, congenital heart disease (with or without correction), kidney disease, neoplasia, post-organ transplant, increased intracranial blood pressure and/or if HTN-associated disease such as neurofibromatosis or tuberous sclerosis [1,4,8].

Children and adolescents with hypertension are usually asymptomatic and HTN is discovered during routine examinations. Symptoms such as headaches, eyesight changes or tiredness may arise if blood pressure values are constantly elevated. On the other hand, end-organ lesions such as left ventricular hypertrophy, thickening of the intima and middle carotid layers, hypertensive retinopathy and microalbuminuria are a frequent and early finding even in asymptomatic children [1].

### Discussion

HTN during childhood and adolescence is a strong predictor of cardiovascular risk in adulthood with persistence of HTN, but also of other diseases such as acute myocardial infarction, stroke and chronic kidney disease [2,7,8]. Thus, it is crucial to identify early the children at risk of developing HTN, both those with an underlying disease that can lead to the development of HTN, as those at high risk of developing primary HTN, in order to apply preventive measures early on and avoid consequences in adulthood. The most important preventive measures to stop the onset of primary HTN in paediatric age include weight loss in children with obesity or overweight, reduction of salt intake and caloric foods, and promotion of physical exercise [1,3].

Initial clinical evaluation should seek to identify risk factors for HTN through past medical history, family diseases, and clinical history [9]. Low birth weight, intrauterine growth restriction,

prematurity, oligo or polyhydramnios, and recurrent urinary infections are some identified risk factors for the development of HTN in childhood and adolescence. The presence of some signs and symptoms such as haematuria, oliguria, polyuria, chest pain, palpitations, headaches or recurrent visual changes should alert us to the possibility of high blood pressure values [9,10]. Family history of diabetes mellitus, hypercholesterolemia, early sudden death, early stroke or acute myocardial infarction, autoimmune diseases or hereditary diseases is also a risk factor for HTN. Medications, caffeine, tobacco and drug abuse should be questioned, especially in adolescents [9,10]. The assessment of the child's weight, food intake and physical exercise should also be evaluated, because overweight and sedentary lifestyles are the main factors for the development of primary HTN. The early identification of the risk factors mentioned, in addition to alerting to the possible development of HTN, allows preventive measures at an early stage in order to avoid elevated blood pressure at young ages [9,10].

As mentioned above, all children from the age of 3 should be evaluated annually for blood pressure, and in particular cases mentioned above, this assessment should be earlier and more frequent.

It is important to highlight that the diagnosis of HTN is not based on a single blood pressure measurement, several measurements are required to establish this diagnosis. In addition to the evaluations performed in the medical consultation environment, home measurements are important, since there are several factors that influence the blood pressure values, such as the child's activity, the consumption of caffeine or other substances, and even anxiety (white coat HTN) [6]. In addition to home and office measurements, it is important to use ambulatory blood pressure monitoring (ABPM) for the correct diagnosis of HTN in paediatric age.

Blood pressure assessment should be done with the appropriate cuff to the child's arm, in the right upper limb, with the child lying or sitting, according to age, after a minimum period of 5 minutes of rest [1,11]. If the first blood pressure assessment is high (higher than P90) two more measurements should be performed [4].

When blood pressure values are high (>P90 but lower than P95) lifestyle changes should be recommended, and further evaluation should be made in 6 months. If in the reassessment the blood pressure values remain high, the evaluation in the four limbs should be made and the importance of lifestyle change should be highlighted. If the values remain high after one year, ambulatory blood pressure monitoring (ABPM) is recommended [4,11].

For blood pressure values consistent with stage I hypertension, measurement should be repeated within 1 to 2 weeks and if they remain high, evaluation should be made on the four limbs with reassessment within 3 months. If the values are consistent with stage I hypertension, ABMP should be performed [4,11].

For blood pressure values consistent with stage II hypertension, blood pressure in the four limbs should be immediately evaluated, with reassessment in one week. If the values remain high, ABMP should be performed and pharmacological treatment should be considered [4,11]. Symptomatic children with stage II hypertension should be treated immediately in the emergency department [4,11]. Blood pressure assessment in the 4 limbs is important to exclude coarctation of the aorta [4,12].

Both the assessment of blood pressure in the office and at home are subject to a high number of errors, so the ABPM plays an important role in the diagnosis of HTN in paediatric age, however this test is only recommended for children older than 5 years [4,13]. In ambulatory blood pressure monitoring, the cuff should be applied to the non-dominant arm to avoid interference with the child's activities. In this exam, blood pressure values are obtained over a period of 24 hours, usually every 20-30 minutes, in the child's usual environment, at home, at school and during other activities (high intensity sports should be avoided) [4,13,14].

With the values obtained by the various measurements, an average blood pressure is calculated and is compared with the tables of percentiles for age, sex and height, such as those made available by the European Society of Hypertension [7].

There are several indications for ABPM use in the presence of high blood pressure values, especially children with type 1 or type 2 diabetes mellitus with high blood pressure values, severe obesity, chronic kidney disease, corrected aortic coarctation, post-kidney, liver or heart transplantation status, HTN-associated genetic syndromes (neurofibromatosis, Turner syndrome, Williams syndrome), in order to confirm the diagnosis of HTN when high values in office measurements were found, in children with end-organ injury (even with normal blood pressure values) and for treatment monitoring [4,8,13,15,16]. An important advantage of ABPM is to be able to diagnose white coat HTN and masked HTN, in which the office values are normal but ambulatory values are high [4,13]. This situation is more common in children with obesity, in those who had surgery for coarctation of the aorta and in those with chronic kidney disease. In these children it is important to periodically evaluate blood pressure and perform ABPM [4]. Furthermore, it is well established that the values obtained by

ABPM are better correlated with the existence of end-organ injury, such as left ventricular hypertrophy [4,8,11].

When the diagnosis of HTN is established, some ancillary diagnostic tests are recommended to identify secondary causes, associated comorbidities, and also end-organ lesions. Thus, it is recommended to perform urine analysis, renal function, electrolyte profile, lipid profile, liver profile, serum glucose, quantification of albuminuria and in those with BMI higher than P95 haemoglobin A1c should be tested [7,11]. In particular situations, thyroid function should be evaluated and abuse drugs should be tested, especially in older children [7]. Renal ultrasonography should be performed in children under the age of 6 years or in those with urine test changes with no other identifiable cause for HTN [11].

Echocardiogram should be performed in all children diagnosed with HTN to exclude heart disease as a cause of HTN, as well as to assess the presence of left ventricular hypertrophy [4,16]. In addition to calculating ventricular wall thickness, the echocardiogram also allows to calculate the ejection fraction that may be decreased in children with HTN. Several echocardiograms are recommended to evaluate disease progression in children with refractory HTN despite correct treatment, in the presence of concentric hypertrophy of the left ventricle or if ejection fraction is decreased [4]. This test is crucial in children with HTN because even if they are asymptomatic, LVH may already be present.

When the diagnosis of HTN is confirmed it is necessary an early intervention to prevent the progression of the disease. The first line of treatment for children with high blood pressure consists of lifestyle changes, promoting healthy eating and physical exercise at least 3 times a week [11]. Consumption of tobacco, caffeine or other drugs should be advised against. For children with persistent high blood pressure values despite lifestyle changes, for those with symptomatic hypertension, stage II hypertension or with evidence of end-organ injury, pharmacological therapy should be initiated [6,11]. However, it should be noted that even if pharmacological therapy is necessary and taken by the child, changes in lifestyle and the practice of physical exercise are still mandatory.

The goal of the treatment is to achieve blood pressure values lower than P90 for children under 13 years old and values below 130/80 mmHg for children over 13 years old [11]. The choice of drugs to be used in treatment should take into account other diseases and comorbidities of the child. Thus, in children with diabetes mellitus with microalbuminuria or chronic kidney disease with proteinuria, the use of angiotensin conversion enzyme inhibitors (ACE Inhibitors) or angiotensin receptor blockers (ARB) is advised.

Calcium channel blockers or beta-blockers are recommended in children with migraine-associated HTN and in those with HTN after aortic coarctation correction [7]. It is important to highlight that there are situations in which the use of certain drugs is not recommended, such as beta-blockers in children with asthma or diabetes mellitus and in children who practice sports; adolescents with a high probability of becoming pregnant should avoid ACE inhibitors and ARB's [7].

As already mentioned, primary HTN is an increasing problem in paediatric age, and this is closely related to overweight and obesity. There is evidence that in these patients, treatment with ACE inhibitors or ARB's should be the treatment of choice [7]. In children and adolescents with primary HTN not associated with obesity there is no evidence of the advantage of one class of drugs instead of the other. Treatment should be started at low doses and should be slowly increased until the desired blood pressure values are reached. When the maximum recommended dose is reached and blood pressure values remain high, the association with another drug of a different class should be considered [7].

The follow-up of children with HTN depends on the cause and associated comorbidities. It should be periodic and will eventually transition to the adult consultation care. In particular cases, in children with high blood pressure and diabetes mellitus or chronic kidney disease, an ABPM should be made every 6-12 months. Echocardiogram should be performed every 6 months in children with left ventricular hypertrophy or uncontrolled HTN. In children with controlled HTN and without end-organ injury the evaluation can be further apart, never exceeding 2 years [7].

### Conclusion

Currently the diagnosis of primary HTN is very common in paediatric age, especially in those with a family history and overweight or obese. Overweight or obese children should be evaluated periodically at the paediatric consultation to assess weight progression. They should be encouraged early-on to lifestyle changes such as a reduced consumption of caloric foods, a reduced salt intake, an increased consumption of vegetables and fruits, and regular exercise (at least 3 times a week). In young smokers, this habit should be warned against. It is also important to regularly assess blood pressure so that children with high blood pressure are identified early, ensuring diagnosis at an early stage of the disease. Thus, early intervention, with or without pharmacological therapy,

is possible in order to reach age-appropriate blood pressure values, to avoid end-organ injury and cardiovascular and cerebrovascular events in adults.

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