Monitoring Pediatric Blood Pressure at Dental Appointments

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ABSTRACT

Numerous studies have tracked blood pressure from adolescence into adulthood. It is increasingly apparent that the recent increase in obesity and resultant end-organ effects of hypertension originates in childhood. Pediatric hypertension is a significant health concern that, if left untreated, can affect a child's cardiovascular, endocrine, renal, and neurologic systems. In 2004, the National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents recommended that bloodpressure should be monitored in pediatric patients who are at least 3years-old and that this procedure should be a part of the health care visit in all health facilities, rather than just within the medical office. The purpose of this article was to emphasize the need for following these recommendations at oral care visits and suggest a simplified pediatric blood pressure table that dental clinicians can use to identify children who need referrals to medical facilities for evaluation of blood pressure.

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In 2004, the National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents (Fourth Report)¹ updated guidelines to assess for prehypertension (**preHPN**) and hypertension (**HPN**) in the pediatric population.¹ Major changes from the previous 1996 guidelines included replacing the former designation of high normal blood pressure (**BP**) values with a new category of pre-HPN and defining HPN levels into stage 1 HPN and stage 2 HPN.¹ Because of the development of a large national database on normative BP levels throughout childhood, the ability to identify children who have abnormally elevated BP has improved.

The Fourth Report¹ summarized the scientific evidence, included a consensus expert opinion regarding BP in children, and provided recommendations for diagnosis, evaluation, and treatment of HPN. They recommended for the first time that BP be monitored on pediatric patients over age 3 and that this procedure should be a part of the health care visit in all health facilities rather than just within the medical office. The American Dental Association has included a recommendation² for screening for HPN in children and adult dental clients since 1976. A search of the American Academy of Pediatric Dentistry Web site for Clinical Practice Guidelines³ revealed only a scant mention of monitoring BP in pediatric clients during routine dental appointments. Therefore, the purpose of this article was to emphasize the need for dental practices to follow the recommendations of the Fourth Report.¹

PEDIATRIC HYPERTENSION

Both preHPN and HPN have become significant health issues in the young.⁴⁻⁸ Numerous studies have found an increased rate of preHPN and HPN among children and adolescents.⁹⁻¹³ Information from the National

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Childhood Blood Pressure data base found that after a single BP measurement, 20% of adolescent boys and 13% of adolescent girls met the criteria for preHPN. Two years later, they evaluated this same group and found the rate of progression from preHPN to HPN was 7% per year.⁹ A cohort study involving 11- to 17-year-olds found the prevalences of preHPN and HPN were 16% and 3%, respectively.¹⁰A longitudinal study of 2086 children and adolescents (8 -17 years) found that over 12 years, baseline systolic BP levels and diastolic BP levels increased an average of 1.4 and 3.3 mm Hg, respectively.¹²

HPN may be primary (essential) HPN or secondary to another disease process.¹ Secondary HPN is more common in children than in adults and is associated with renal disease, coarctation of the aorta, and endocrine diseases.^{4,5} Most children and adolescents who exhibit mild to moderate HPN have primary HPN.^{1,6} Although the exact cause of primary HPN is unknown, numerous studies have suggested that it is associated with a family history of HPN, diabetes, high cholesterol, obesity, and ethnic groups (American Indians, Asians, Afro-Caribbeans, and Hispanics).^{7,8,13-21}

Although it was formerly thought that HPN children were not at risk for developing organ damage,²² the Fourth Report described evidence of early target organ damage in children and adolescents.¹ On the basis of developing evidence, it is apparent that primary HPN is detectable in the young and occurs commonly. The long-term risk for cardiovascular disease is substantial, and it is important that measures be taken to reduce these risks. For these reasons, the Fourth Report Working Group recommended that children who are at least 3-years-old should routinely have their BP measured. Specific medical conditions may indicate measuring BP in clients younger than 3-years-old, such as prematurity, congenital heart disease, or recurrent urinary tract infections.¹

PRIMARY HYPERTENSION RISK FACTORS

Even though the prevalence of primary HPN is lower in children and adolescents than in adults, primary HPN encompasses the majority of HPN in children. Children from families who have a history of HPN tend to have higher BP than children from normotensive families.²¹ Primary HPN also has been associated with other cardiovascular risk factors, such as overweight, insulin resistance, and dyslipidemia.^{5,6,8,14,15,18-21}

The association between obesity and HPN in children has been reported in a variety of ethnic and racial groups. Results have found that overweight children have a higher prevalence of HPN when compared to lean children.^{5,6,8,18,23-25} The Bogalusa Heart Study demonstrated that overweight schoolchildren were 4.5 times more likely to have elevated systolic BP and 2.4 times more likely to have an elevated diastolic BP.²³ Similar results were found in obese adolescents who participated in a school-based HPN and obesity screening study.⁴ Recently, a study found that, out of 167 obese children, 31% (N=53) had an elevated BP vs 3% of the control participants (N=1).¹⁸ They also found that obese children with elevated BP had a significantly higher body mass index and body mass index z-scores (body mass index z-scores are measures of relative weight adjusted for child age and sex). A national survey, found an increase in the prevalence of high BP in children and concluded that the increase was largely attributable to the increase in childhood obesity.²⁵

Obesity-related HPN primarily affects the patient's systolic BP. Data from a multicenter trial of an antihypertensive medication in children¹⁷ found that, among 2,460 subjects who enrolled in the study, the prevalence of isolated systolic HPN was 33% in obese subjects compared with 11% in nonobese subjects.¹⁷ Those adolescents who were obese also had a higher resting heart rate.¹⁷ Prevention of excess weight or abnormal weight gain often reduces the risk for HPN; therefore, a primary therapy of obesity-related HPN is weight control or reduction.¹⁷

A recent study reported that teens who were obese and overweight had a higher risk not only for HPN but also for type 2 diabetes mellitus (**DM**) and fatty liver disease.¹⁴ Overweight children frequently have some degree of insulin-resistance. HPN is a complication of DM, and in the United States, newly diagnosed type 2 DM was reported in 8% to 45% of young children, particularly among aforementioned ethnic groups.^{15,16}

TARGET ORGAN ABNORMALITIES IN CHILDHOOD HYPERTENSION

A number of target organs in children and adolescents are affected by HPN. High BP in children can lead to hypertensive encephalopathy, seizures, cerebrovascular accidents, and congestive heart failure.26,27 The most common organ affected in the pediatric population, however, is the heart.¹ Studies have found that a significant number of children and adolescents who have either preHPN or HPN also had left ventricular hypertrophy (LVH).^{28,29} LVH has been reported in 27% to 41% of children and adolescents who have uncontrolled HPN.^{30,31} Studies have found that the prevalence of LVH, specifically in obese children, ranged between 16% and 41%.^{32,33} One study found that 27% of adolescents with systolic HPN had LVH,³⁰ and another correlated LVH with elevated BMI.33 In pediatric patients with established HPN, echocardiographic assessment of the left ventricle is indicated at the initial diagnosis and periodically to assess and document changes.

An additional target organ affected by HPN is the brain. Studies have found that young adults who exhibit mild HPN do not perform as well on neuropsychological tests when compared to normotensive patients.^{34,35} Furthermore, cognitive function was improved in young adults with HPN once antihypertensive therapy was implemented.³⁴ Additionally, children and adolescents with a systolic BP greater than the 90th percentile (Pre-HPN) had poorer performances on selected cognition tests (digit span, block design, and mathematics) when compared to children who were not hypertensive.³⁶ They suggest that HPN treatment should be directed at lowering systolic BP even when diastolic pressure is normal and that early treatment can prevent cognitive deficits.³⁶

UNDERDIAGNOSIS OF PEDIATRIC HYPERTENSION

HPN diagnosis in children is complicated because normal and abnormal BP values vary with age, sex, and height percentile and are, therefore, difficult to ascertain. A cohort study of 14,187 3- to 18-year-olds determined that 75% of HPN and 89% of preHPN is undiagnosed in pediatric populations and that a variety of factors increased the odds of misdiagnosis.¹³ One factor inhibiting health care practitioners from screening for elevated BP levels in the pediatric population is the difficulty in interpreting tables included within the Fourth Report guidelines, which requires ascertaining a child's height percentile to find the BP values.¹ Another study determined that procedural errors were responsible for errors in obtaining valid BP values.³⁷

PEDIATRIC BLOOD PRESSURE TABLES

The updated BP tables for children and adolescents included in the Fourth Report include different tables for males and females based on normalization of BP values for 7 height percentiles from the 1999-2000 National Health and Nutrition Examination Survey. It is clear that using the current tables (which requires knowing the height percentile of the client) is difficult and reduces the likelihood of health care facilities to comply with the recommendations that all pediatric appointments for health care include monitoring BP. Recently, a simplified table was published to resolve this issue (Table 1).³⁸ When BP values equal or are higher than the values listed in the simplified table for the child's sex and age, the pediatric client should be referred for medical evaluation of BP.

CURRENT CLINICAL PRACTICE GUIDELINES

The guidelines for monitoring BP in dental patients are well described and have been implemented since 1976 by the American Dental Association.^{2,39-41}These guidelines mandate that BP be measured at every dental visit for patients with known HPN or cardiovascular risk factors as part of the standard for dental care. Routine screening for HPN by dental health professionals is critical because many individuals are unaware of the condition or may not be adequately controlled.⁴² Those without known risk factors should have BP measured at every annual or semiannual recall appointment to screen for HPN.^{2,39,41}

High BP may indicate an acute or uncontrolled chronic medical condition, and referral for medical evaluation

is imperative before beginning dental treatment. Adult patients with a BP of at least 180/110 should be referred to their primary health care practitioners immediately and elective dental treatment should be postponed.^{39,43,44} Patients receiving medical intervention for HPN should have their BP evaluated before any dental procedure that requires the use of local anesthetics, conscious sedation and/or general anesthesia.⁴³ Stress reduction protocol also should be implemented while treating these patients. A recent systematic review concluded that epinephrine in local anesthetic solutions can be used safely in adults with known HPN.⁴⁵ Caution is advised when using epinephrine containing local anesthetics for patients who take nonselective beta-blockers and nonpotassium-sparing diuretics or who have a history of cardiovascular disease.^{39,45}

MONITORING PEDIATRIC HPN: A NEW RESPONSIBILITY IN PEDIATRIC DENTAL CARE

This discussion is based on the updated classification of HPN in children by the 2004 National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents, which recommends that all children older than 3-years-old have BP measured at all health care encounters, including both well care appointments and appointments for intervention.¹

Table 1.	Blood Pressure Values, by Age and Gender,
Needing	Further Evaluation*

	Males		Females	
Age (ys)	Systolic BP (mmHg)	Diastolic BP (mmHg)	Systolic BP (mmHg)	Diastolic BP (mmHg)
3	100	59	100	61
4	102	62	101	64
5	104	65	103	66
6	105	68	104	68
7	106	70	106	69
8	107	71	108	71
9	109	72	110	72
10	111	73	112	73
11	113	74	114	74
12	115	74	116	75
13	117	75	117	76
14	120	75	119	77
15	120	76	120	78
16	120	78	120	78
17	120	80	120	78
≥18	120	80	120	80

* These values, adapted from The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents (2004)' represent the lower limit for abnormal blood pressure (BP) by age and gender.³⁹ Any BP reading at or higher than these values represent BPs in the preHPN, stage 1 HPN, or stage 2 HPN range for most pediatric individuals and, therefore, should be further evaluated by a physician. Pediatric HPN has become a great concern for health care professionals and should be a significant concern for the dental professional.

A recent publication reviews the epidemiology and management of pediatric HPN in oral care settings. The authors provide a suggested protocol for screening pediatric patients for HPN in the dental setting and highlight specific actions required prior to, during, and post dental treatment. They also offer a pediatric oral health protocol for management of the hypertensive child in the dental setting and recommend that children with poorly controlled HPN should avoid the use of local anesthetics with vasoconstrictors.⁴⁸

Revision of the classification of BP stages and guidelines for management were designed to increase the awareness concerning the prevalence of pediatric HPN and its potential complications. As advocates for health care professionals and the welfare of children, we suggest that the current pediatric dental guidelines include BP measurements to be taken in children who are at least 3-years-old. Since the pediatric patient population includes special needs children who require multidisciplinary care, these guidelines also are applicable to all individuals who provide oral care to medically compromised children and adolescents. In addition, children from indigent families may not see a physician on an annual basis but may visit a dentist who accepts federally funded dental programs.

The simplified pediatric BP table presented here could serve as a guide for normal values for children based on their ages and genders during initial evaluation of a child who is at least 3-years-old. This may enable easy identification of a child or adolescent in need of referral for medical evaluation for possible HPN prior to invasive oral procedures and those who require an alteration of the dose of vasoconstrictor used in the oral procedure.

CONCLUSIONS

Based on this study's results, the following conclusions can be made:

- 1. The 2004 National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents recommends that all children who are at least 3-years-old have their blood pressure (BP) measured at all health care visits.
- 2. Pediatric hypertension (HPN) is a significant health concern that, if left untreated, can affect a child's cardiovascular, endocrine, renal, and neurologic systems and lead to adult HPN and cardiovascular disease.
- 3. A simplified BP table has been developed as a screening tool for health care practitioners. Dental practitioners can utilize this table during the evaluation of the pediatric patient's blood pressure. Appropriate medical referral should be initiated in children whose BP levels are at the values listed in Table 1.

4. The American Academy of Pediatric Dentistry should review these new guidelines and consider incorporating them as the standard of care for all pediatric dental patients.

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