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Research Article

Impact of ambulatory blood pressure monitoring on the diagnosis of hypertension in children

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Abstract

Screening of hypertension in children commonly starts with office measurement of the blood pressure according to the Fourth Report. The latter however does not account for masked hypertension (MH) on the one hand and white coat hypertension (WCH) on the other. We aimed to investigate in a single large pediatric population how much the addition of ambulatory blood pressure monitoring (ABPM) helps to refine the allocation to the different classes of blood pressure. In a retrospective study, we reclassified the records of a cohort of 500 children, who attended our department for investigation of possible hypertension, according to the Fourth Report and the revised ABPM interpretation scheme. As expected, ABPM interpretation scheme detected MH and WCH; however, 14% of children evaluated according to this scheme did not fit in any categories. On the other hand, applying the Fourth Report criteria, 80% of prehypertensive children ended up in the uncategorized or the MH groups. Our data confirm that ABPM detects the cases of MH and WCH, and minimizes the misplacement of prehypertensive children; unfortunately however, it also leaves a significant number of patients remain unclassified. J Am Soc Hypertens 2015;9(10):780–784.

Keywords: Clinic blood pressure; masked hypertension; prehypertension; white coat hypertension.

Introduction

Recent literature data demonstrated that an increasing number of children are hypertensive or in a clinical condition referred to as ''prehypertension,'' with blood pressure readings, just short of hypertension.[1] However, high blood pressure in children is often asymptomatic[2] and detected only at well-child visits.

Our routine method of screening for hypertension is an office measurement[2] using sphygmomanometer and stethoscope and we classify the blood pressure level according to the Fourth Report of the National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents (Fourth Report).[2] This method does not contemplate the diagnosis of white coat hypertension (WCH)[3] and masked hypertension (MH).[4]

Currently, many authors use the Ambulatory Blood Pressure Monitoring (ABPM) in routine screening for hypertension. They advocate the added advantage of 24-hour recording in the child natural environment. The ABPM already proved a more specific method for the diagnosis of hypertension in childhood.[5,6] ABPM is superior to clinic readings for evaluating cardiovascular risk in children[7,8] as well as in adults,[9] is more efficient in separating nocturnal dippers from non-dippers,[10] and above all can detect children affected by MH[11] as well as WCH.[12]

In 2008, Urbina et al[13] published a recommendation for a Standard Assessment of ABPM in Children and Adolescents. They recommended assessing the blood pressure condition in children suspected to have hypertension by associating the single office measurement with the blood pressure parameters recorded with ABPM (ie, mean ambulatory systolic blood pressure (SBP) and SBP load). In 2014, Flynn et al published an update of Urbina's scientific statement of ABPM in children and adolescents. The

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"revised scheme for staging of ambulatory blood pressure levels in children" uses the following parameters: office blood pressure, mean ambulatory SBP or diastolic blood pressure (DBP), and SBP or DBP load.

We aim to investigate in a single large pediatric population how much the addition of ABPM helps to refine the allocation to the different classes of blood pressure.

Methods

Aims of the study are:

- to classify the blood pressure status in children according to the Fourth Report classification[2] and the revised interpretation scheme for ABPM[14];
- to assess the level of correspondence between the two classifications.

From the clinical records of the children referred to the day hospital of our Pediatric Nephrology Unit, from January 2012 to March 2014 to rule out hypertension, we extracted the SBP and DBP readings, obtained in clinic as well as ABPM.

The study protocol conformed to the ethical guidelines of the 1975 Declaration of Helsinki as revised in 2000[15] and was approved by the ethic committee of our institutions. Inclusion criteria were aged between 5 and 16 years; a height of at least 120 cm; absence of other chronic diseases and/or body mass index for age percentiles $\geq$95 percentile; no previous therapy known to have effect on the blood pressure. Initial evaluation consisted of complete history and physical examination, and blood pressure taken by a trained nurse on all four limbs, to rule out the possibility of an aortic coarctation. At two additional appointments scheduled within the week, the blood pressure was checked in the right arm. The following week, we did routine blood analyses and a 24-hour ABPM. We recorded the results in our database.

Blood Pressure Measurement Technique

We selected the size of the blood pressure cuff according to the recommendations of the Fourth Report.[2] We considered the first and the last of Korotkoff sounds (K1 and K5) to mark the SBP and DBP. The mean of three replicate BP readings, taken approximately 1 minute apart with the recipient in a sitting position after 5 minutes rest, was recorded as the recipient's clinic SBP and DBP.

We recorded ABPM on the nondominant arm using a validated noninvasive portable oscillometric device (SpaceLabs model 90207; SpaceLabs Inc., Redmond, WA, USA).[16] Based on the observation of the patient's sleep-wake pattern in the preceding 7 days, we set the ABPM device for daytime and nighttime. We programmed the recorder to measure BP every 20-minute during the daytime and every 30-minute during nighttime. The children, together with their parents, received detailed instructions on the procedure and were encouraged to maintain their usual activities. The parents were instructed to report in a diary all events occurring during the 24 hours of the recordings, including the child's waking and sleeping times.

Classification of Blood Pressure

All children entered in the study had their pressure classified as follows.

Based on the mean blood pressure obtained from the three office measurements, the children were initially allocated to one of the four groups considered in the Fourth Report[2]: normal (N), prehypertension (PH), stage 1 hypertension (H I), and stage 2 hypertension (H II).

After completion of ABPM, we reclassified all children according to the revised interpretation scheme of the updated recommendations for the standard assessment of ABPM in children and adolescents.[14] After the "2014 American Heart Association Scientific Statement classification" and "AHA pediatric ABPM statement,"[14] which included both clinic and ABPM measures, we formed the following groups: normal blood pressure (N), WCH, PH, MH, ambulatory hypertension, and severe ambulatory hypertension. All patients that did not fit in any of the classes in both classifications formed a separate group named uncategorized patients. Two physicians independently assigned the patients to the classes of hypertension. Then the two physicians together went over the allocation and did it again with the head of the unit.

Statistical Analysis

We used a contingency analysis to verify the distribution between the allocation of the patients within the classification system of the Updated statement for the ABPM classification[14] and the Fourth Report.[2] The contingency analysis explores the distribution of a categorical (nominal or ordinal) variable across the levels of a second categorical variable. Whenever necessary, we applied the chi-square test to the percent differences among classes.

Results

From January 2012 to March 2014, we performed 1247 visits for hypertension. The clinical records of 500 children, 320 males and 180 females, with a mean age of 13 $\pm$ 3 years (range, 17–6 years) fulfill the requirements of the protocol.

Figure 1 demonstrates how resorting to either classification of blood pressure, the allocation of the patients in blood pressure groups changes. Although the number of prehypertensive patients is similar (p = NS), the IV report classification recognizes a larger number of normal ($P < .0001$) and of hypertensive ($P < .0001$) children. Figure 1 shows also that using the updated statement for