

Research Article

Obstructive sleep apnea and periodic limb movement disorder in a population of children with hypertension and/or nocturnal nondipping blood pressures



Kimberly Hartzell, MD^{a,*}, Kristin Avis, PhD, CBSM^a, David Lozano, MD^a, and Daniel Feig, MD, PhD, MS^b

^aDivision of Pulmonary and Sleep Medicine, Department of Pediatrics, University of Alabama at Birmingham, Birmingham, AL, USA; and

^bDivision of Nephrology, Department of Pediatrics, University of Alabama at Birmingham, Birmingham, AL, USA

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Abstract

There is a reported association between hypertension (HTN) and sleep disorders. The American Academy of Pediatrics recommends screening children with HTN for sleep disorders because sleep disorders increase the risk for cardiovascular disease. We quantified the frequency and severity of sleep disorders within our institution's hypertensive pediatric population and evaluated the effectiveness of performing nocturnal polysomnography (NPSG). In the hypertensive pediatric population referred for NPSG at our institution, 64% were diagnosed with obstructive sleep apnea (OSA) and/or periodic limb movement disorder. Thirty-three percent of those children with HTN had moderate to severe OSA, whereas only 20% of all children evaluated by NPSG had moderate to severe OSA. Those children with HTN were also two times more likely to be diagnosed with periodic limb movement disorder. Screening for sleep disorders and obtaining NPSG in children with HTN increase the identification of comorbid sleep disorders and reduce the risk for cardiovascular disease. *J Am Soc Hypertens* 2016;10(2):101–107. © 2016 American Society of Hypertension. All rights reserved.

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Introduction

The need to identify and treat hypertension (HTN) in the pediatric population is becoming increasingly evident as studies are showing that elevated blood pressure (BP) in childhood leads to end-organ damage, with some changes seen as early as adolescence in those with a prehypertension diagnosis.^{1–3} One of the most valuable tools for diagnosing HTN is ambulatory blood pressure monitoring

(ABPM). Because ABPM is obtained over a 24-hour period and during normal daily activities, a large number of BP readings are obtained in multiple, nonmedical settings.^{4,5} This cache of data provides the physician with a more accurate representation of the patient's systolic pressures, diastolic pressures, mean pressures, and the circadian BP variability. These data can then be used to diagnose white coat HTN, masked HTN, prehypertension, sustained HTN, isolated nighttime HTN, and other BP variations such as a nondipping BP.^{6,7} The early detection of a BP abnormality will lead to close monitoring, early detection and prevention of end-organ damage, and the identification of other comorbid conditions, such as sleep disorders, that may contribute to worsening HTN.^{8,9}

One of the most common sleep disorders is obstructive sleep apnea (OSA) which has a reported prevalence of 0.1%–13% within the general pediatric population.^{10–12} It is a disease that all pediatricians need to be watchful for because it can have short-term and long-term effects on cognition, the cardiovascular system, growth, and

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*Corresponding author: Kimberly Hartzell, MD, Division of Pulmonary and Sleep Medicine, Department of Pediatrics, University of Alabama at Birmingham, 1600 7th Ave South, JFL 620, Birmingham, AL 35233-1711. Tel.: 205-638-9583; Fax: 205-975-5983.

E-mail: kimhartzell@yahoo.com

inflammation.¹⁰ There has also been a growing body of literature linking OSA to HTN, and the American Academy of Pediatrics (AAP) has recommended in the Fourth Report on the Diagnosis, Evaluation, and Treatment of high Blood Pressure in Children and Adolescents that all children with HTN should be screened for sleep-disordered breathing.^{9,13–15} The cardiovascular effects of periodic limb movement disorder (PLMD) and/or restless leg syndrome have yet to be fully explored, but they have been shown in several articles, mostly in the adult population, to have a potential role in cardiovascular disease.^{16–18} It was our goal with this study to quantify the frequency and severity of sleep disorders within our institution's hypertensive pediatric population.

Materials and Methods

An application for Institutional Review Board approval was completed and submitted to the University of Alabama at Birmingham's Institutional Review Board for Human Use. This study received expedited review approval.

A retrospective chart review was undertaken to identify all pediatric patients who had been seen within the Children's of Alabama health care system who had both ABPM and polysomnography (NPSG) performed. Electronic medical records system queries identified patients diagnosed with "elevated blood pressure," "hypertension," "obstructive sleep apnea," "polysomnography," and "ambulatory blood pressure monitoring." Databases kept by our sleep center were also reviewed to identify patients who had been referred for NPSG secondary to a diagnosis of HTN. The data pool was constrained to include only those patients who had both NPSG and ABPM completed within 1 year of each other to help prevent treatment and growth effects on outcomes.

The patients' age, height, and weight were recorded from the clinic visit where ABPM was initiated or the nephrology clinic visit closest to the initiation of the ABPM. Body mass index (BMI) was calculated for each patient by using the formula $BMI = \text{weight}/\text{height}^2$, and the BMI z-score was calculated. The ABPM data were recorded into our database and were deemed to be positive or negative based on the normative ABPM data and recommendations provided in the American Heart Association's Scientific Statement on Ambulatory Blood Pressure Monitoring in Children and Adolescents: Recommendations for Standard Assessment by Urbina et al.¹⁹ A patient's ABPM was deemed abnormal if the BP values were elevated during 1 or more of the following periods: daytime, nighttime, or total time of monitoring. We also identified those patients whose BP (systolic, diastolic, or both) dropped less than 10% during sleep and classified them as "nondippers." The sleep study data for each of these patients were recorded into our database. We focused on the sleep efficiency, apnea-hypopnea index (AHI), number of

periodic limb movements (PLM), and the periodic limb index for each patient. Once the AHI was recorded, each patient was further categorized into no OSA (AHI < 1), mild OSA (AHI of 1 or more but less than 5), moderate OSA (AHI of 5 or greater but less than 10), or severe OSA (AHI of 10 or greater). A patient was considered to have PLMD if their PLM index was equal to or greater than 5. To establish a control group, we reviewed our sleep center's data for a 1-year period and identified all initial sleep studies to obtain our institution's rate of OSA, OSA severity, and PLMs in all children referred to our center for an initial sleep study. Those children with genetic disorders or malformations that predispose to a sleep disorder were excluded from this data analysis.

Statistics

Our data were analyzed by calculating the prevalence of sleep disorders among patients with HTN and by using the chi-squared test and Fisher's exact test to determine statistical significance in the categorical variables. Analysis of variance and the two sample t-test were used to evaluate the continuous variables for statistical significance. A *P*-value of <.05 was considered significant.

Results

Through our search methods, we identified 63 patients who had both ABPM and NPSG completed over the prior 12 years. Of these 63 patients, 60 did not carry a diagnosis of HTN before the ABPM. Six of these 60 patients had more than a year between the ABPM and NPSG and therefore were excluded from our data set (Figure 1). The final data set analyzed contained 54 patients who had NPSG and ABPM completed within 1 year of each other and who did not carry a diagnosis of HTN before the ABPM. Thirty-two (59%) were male, 32 (59%) were African American, and the mean BMI z-score of these patients was 2.1. Thirty-nine (72%) of these patients had a BMI z-score of 2 or greater. The ages of these children ranged from 5 to 18 years. There were 33 patients (61%) diagnosed with HTN by ABPM. Of these 33 children with HTN, 17 patients were male (51.5%), 21 (64%) were African American, and the mean BMI z-score was 2.0 (Table 1). The mean sleep efficiency of this group of sleep studies was 88%. Among this group, 21 (64%) children were diagnosed with a sleep disorder (OSA and/or PLMD). Eighteen (54.5%) of these children had an AHI >1, and 11 (33%) had an AHI >5 (Figure 2). Diastolic, systolic, or both pressures decreased less than 10% during the nighttime in 61% (20/33). Seven (21%) of these children with HTN were found to have PLMD which is double the prevalence of children diagnosed with PLMD in the general population evaluated by our sleep center (10%) (Figure 3).

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